THE

SILVA OF NORTH AMERICA

BY

CHARLES SPRAGUE SARGENT

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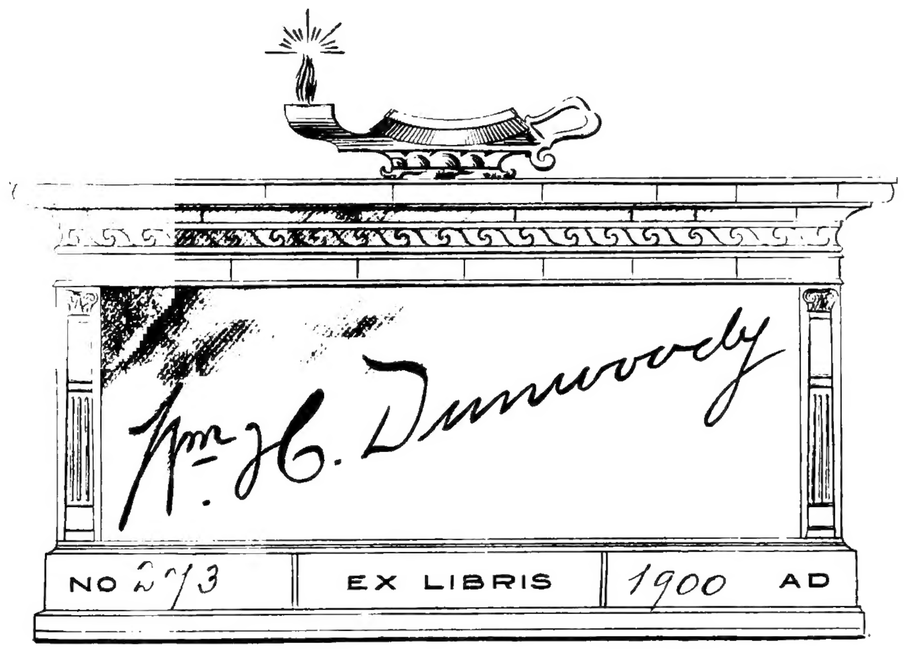

THE

SILVA OF NORTH AMERICA

A DESCRIPTION OF THE TREES WHICH GROW NATURALLY IN NORTH AMERICA EXCLUSIVE OF MEXICO

BY

CHARLES SPRAGUE SARGENT

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OF HARVARD UNIVERSITY

Illustrated with Figures and Analyses drawn from Nature

BY

CHARLES EDWARD FAXON

VOLUME IX

CUPULIFERÆ — SALICACEÆ

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THIS VOLUME IS DEDICATED TO THE MEMORY OF

GEORGE BARREL EMERSON,

AUTHOR OF THE REPORT ON THE TREES AND SHRUBS OF

MASSACHUSETTS, WHOSE INTELLIGENCE

AND FORETHOUGHT IN

PROVIDING FOR THE ESTABLISHMENT OF THE ARNOLD

ARBORETUM HAS MADE POSSIBLE

THE PREPARATION OF

THE SILVA OF NORTH AMERICA

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SYNOPSIS OF THE ORDERS OF PLANTS CONTAINED IN VOLUME IX. OF THE SILVA OF NORTH AMERICA.

Class I. DICOTYLEDONOUS or EXOGENOUS PLANTS.

Stems increasing in diameter by the annual addition of a layer of wood inside the bark. Leaves netted-veined. Embryo with a pair of opposite cotyledons.

Sub-Class I. Angiospermæ. Pistil, a closed ovary containing the ovules and developing into the fruit.

Division III. Apetalæ. Corolla 0. Stamens inserted on the petaloid calyx, or hypogynous.

51. **Cupuliferæ.** Flowers monœcious or rarely perfect. Stamens 2 to 4 or indefinite. Ovary inferior, after anthesis imperfectly 2 to 3 or rarely 4 to 6-celled. Ovule solitary, or in pairs, ascending or descending, anatropous. Fruit a nut usually more or less inclosed in bracts free or united into a woody involucre. Leaves alternate, stipulate.

52. **Betulaceæ.** Flowers monœcious. Stamens 2 to 4. Ovary inferior, 2-celled. Ovule solitary, suspended, anatropous. Fruit a nut covered by the deciduous or persistent scales of a strobile. Leaves alternate, stipulate.

53. **Myricaceæ.** Flowers monœcious or diœcious. Stamens usually 4 to 6. Ovary inferior, 1-celled. Ovule solitary, erect, orthotropous. Fruit drupaceous, often covered with a waxy exudation. Leaves resinous-punctate, alternate, rarely stipulate.

54. **Salicaceæ.** Flowers monœcious. Perianth 0. Stamens 2 or many. Ovary 1-celled. Ovules numerous, ascending, anatropous. Fruit a 2 to 4-valved capsule. Leaves alternate, stipulate.

SILVA OF NORTH AMERICA.

CASTANOPSIS.

FLOWERS unisexual, monœcious, apetalous, in erect unisexual or androgynous aments; calyx 5 to 6-lobed, or parted, the lobes imbricated in æstivation; stamens usually 10 to 12; pistillate flower included in an involucre of scale-like bracts; ovary inferior, 3-celled; ovules 2 in each cell, ascending. Fruit a nut inclosed in the accrescent spiny or tuberculate involucre. Leaves alternate, penniveined, stipulate, persistent.

Castanopsis, Spach, *Hist. Vég.* xi. 185 (1842). — A. de Candolle, *Jour. Bot.* i. 182. — Bentham & Hooker, *Gen.* iii. 409.

Castanea, Endlicher, *Gen.* 275 (in part) (1836). — Baillon, *Hist. Pl.* vi. 257 (in part). — Prantl, *Engler & Prantl Pflanzenfam.* iii. pt. i. 54 (in part).

Callæocarpus, Miquel, *Pl. Jungh.* i. 13 (1851).

Trees or rarely shrubs, with watery juice, scaly bark, astringent wood, terete branchlets, buds covered by numerous imbricated scales, stout perpendicular tap-roots and thick rootlets. Leaves convolute in the bud, alternate, five-ranked, usually coriaceous, entire or dentate, penniveined, the secondary veins inconspicuous or rarely prominent, persistent. Stipules obovate or lanceolate, scarious, generally caducous. Flowers monœcious, unisexual, anemophilous, in three-flowered cymes, or the pistillate rarely solitary or in pairs, in the axils of minute bracts, the lateral flowers subtended by small although otherwise similar bracts, on slender erect aments from the axils of the leaves of the year, the staminate flowers on usually elongated and panicled aments, the pistillate on shorter simple or panicled aments or scattered at the base of the staminate inflorescence. Calyx of the staminate flower campanulate, five or six-lobed or parted, the lobes or segments imbricated in the bud. Stamens indefinite, usually ten or twelve, inserted on a slightly thickened torus; filaments filiform, elongated, exserted; anthers oblong, attached on the back, introrse, two-celled, the cells parallel, contiguous, opening longitudinally. Ovary rudimentary, minute, hirsute. Pistillate flowers surrounded by an involucre of imbricated scales. Calyx urceolate, the short limb divided into six obtuse biserrate lobes. Stamens inserted on the limb of the calyx, usually as many as and opposite its lobes, abortive. Ovary inferior, three-celled after fecundation. Styles generally three, linear, spreading, slightly exserted from the involucre; stigmas terminal, minute. Ovules two in each cell, attached to its interior angle, semianatropous; micropyle superior. Fruit maturing at the end of the second season; involucre containing from one to four nuts, ovoid or globose, sometimes more or less depressed, rarely obscurely angled, dehiscent or indehiscent, armed with stout spines, tuberculate, or marked with interrupted vertical ridges. Nuts inclosed in the involucre, more or less angled by mutual pressure when more than one, often pilose, crowned with the remnants of the styles, attached at the base by large conspicuous circular depressed umbilici; pericarp of two coats, the outer cartilaginous or bony, the inner thinner, sometimes tomentose on the inner surface. Seed usually solitary by abortion, filling the cavity of the nut, marked

at the apex by the abortive ovules,[1] exalbuminous, hypogæous; testa membranaceous; cotyledons plano-convex, fleshy, farinaceous; radicle minute, superior, included between the cotyledons, the hilum basal, minute.[2]

Of Castanopsis, which is intermediate in its characters between the Oak and the Chestnut, about twenty-five species are now recognized. One inhabits the forests of Pacific North America, and the others southeastern Asia, where they are distributed from southern China through Malaya to the eastern Himalayas.[3]

Comparatively little is known of the economic properties of the Chinese and Malayan species. Some of those of India produce strong durable wood used in construction, and edible nuts.[4]

In North America Castanopsis is not known to be seriously injured by insects and is comparatively free from the attacks of fungal diseases.[5]

Castanopsis, from *κάστανα* and *ὄψις*, was first used as the name of a section of Quercus,[6] to which some of the Indian species were originally referred.

[1] A. de Candolle, *Ann. Sci. Nat.* sér. 4, xviii. 53.

By A. de Candolle (*Jour. Bot.* i. 182) the species of Castanopsis are grouped in two sections: —

EUCASTANOPSIS. Fruiting involucres beset with ridged spines, dehiscent or indehiscent.

CALLÆOCARPUS. Fruiting involucres tuberculate or ridged, dehiscent or indehiscent.

[2] By Baillon (*Hist. Pl.* vi. 233) Castanopsis was considered a section of Castanea, from which it differs principally in its three-celled ovary, and this view has been adopted by Prantl (*Engler & Prantl Pflanzenfam.* iii. pt. i. 55), while G. King (*Ann. Bot. Gard. Calcutta*, ii. 18 [*Indo-Malayan Species of Quercus and Castanopsis*]), although retaining the genus on the ground of convenience, could find no characters by which it could be satisfactorily separated from the section Chlamydobalanus of Quercus.

[3] Blume, *Bijdr. Fl. Ned. Ind.* 525 (Castanea); *Mus. Bot. Lugd. Bat.* i. 282 (Castanea). — Spach, *Hist. Vég.* xi. 185. — Blume & Fischer, *Fl. Jav.* i. 37 (Castanea). — Miquel, *Fl. Ind. Bat.* i. 868 (Castanea and Callæocarpus); Suppl. 352; *Ann. Mus. Lugd. Bat.* i. 118. — Bentham, *Fl. Hongk.* 319 (Castanea). — A. de Candolle, *l. c.*; *Prodr.* xvi. pt. ii. 109. — Hance, *Jour. Bot.* xiii. 367; xvi. 200; xxii. 230. — Kurz, *Forest Fl. Brit. Burm.* ii. 477 (Castanea). — Franchet, *Nouv. Arch. Mus.* sér. 2, v. 277 (*Pl. David.* i.). — Hooker f. *Fl. Brit. Ind.* v. 619. — G. King, *l. c.* 93.

[4] Brandis, *Forest Fl. Brit. Ind.* 490. — Gamble, *Man. Indian Timbers*, 388.

[5] *Castanopsis chrysophylla* is subject to the attacks of *Taphrina cœrulescens*, Tulasne, a fungus which is also common on the leaves of several species of Quercus, forming ash-colored patches on their under surface.

[6] D. Don, *Prodr. Fl. Nepal.* 56 (1825).

CASTANOPSIS CHRYSOPHYLLA.

Chinquapin. Golden-leaved Chestnut.

LEAVES lanceolate or oblong, coated on the lower surface with bright golden yellow scales. Involucres of fruit covered with stout divergent spines, dehiscent; nut usually solitary.

Castanopsis chrysophylla, A. de Candolle, *Jour. Bot.* i. 182 (1863); *Prodr.* xvi. pt. ii. 109. — Watson, *King's Rep.* v. 322. — Brewer & Watson, *Bot. Cal.* ii. 100. — Torrey, *Bot. Wilkes Explor. Exped.* 463. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 156. — Coville, *Contrib. U. S. Nat. Herb.* iv. 198 (*Bot. Death Valley Exped.*). —Dippel, *Handb. Laubholzk.* ii. 59.

Castanea chrysophylla, Hooker, *Fl. Bor.-Am.* ii. 159 (1839); *Lond. Jour. Bot.* ii. 496, t. 16; *Bot. Mag.* lxxxii. t. 4953. — Nuttall, *Sylva*, i. 21. — Torrey, *Pacific R. R. Rep.* iv. pt. v. 137; *Bot. Mex. Bound. Surv.* 205. — Morren, *Belg. Hort.* vii. 248, t. 240. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 27, 89, f. 4. — *Fl. des Serres*, xii. 3, t. 1184. — Kellogg, *Proc. Cal. Acad.* ii. 280. — Bolander, *Proc. Cal. Acad.* iii. 231. — Engelmann, *Rothrock Wheeler's Rep.* vi. 375. — Koehne, *Deutsche Dendr.* 122. — Greene, *Bot. Bay Region*, 304.

Castanea sempervirens, Kellogg, *Proc. Cal. Acad.* i. 71 (1855).

A tree, from one hundred to one hundred and fifty feet in height, with a massive trunk from five to ten feet in diameter and frequently free of branches for eighty feet above the ground,[1] and stout spreading limbs which form a broad compact round-topped or conical head; generally much smaller and sometimes, especially at high elevations and at the south, reduced to a low shrub with slender diverging stems.[2] The bark of the trunk is from one to nearly two inches in thickness and is deeply divided into rounded ridges from two to three inches broad, broken into thick plate-like scales, dark red-brown on the surface and bright red internally. The branchlets are slender and rather rigid, and, when they first appear in early summer, are coated with bright golden yellow scurfy scales; during their first winter they are dark reddish brown, slightly scurfy, and marked with minute scattered white lenticels, and in their second season gradually grow darker. The winter-buds attain almost their full size with the completion of the growth of the branch at midsummer, and are usually crowded near its extremity; they are ovate or subglobose and covered by numerous broadly ovate apiculate thin and papery light brown scales, slightly puberulous on the back and ciliate on the scarious and often reflexed margins, and in falling mark the base of the branch with many persistent ring-like scars; the terminal bud is about a quarter of an inch in length and breadth and rather larger than the axillary buds, which are often stipitate. The leaves are convolute in the bud, lanceolate or oblong, gradually narrowed at both ends or sometimes abruptly contracted at the apex into short broad points, and entire, with slightly thickened revolute margins; when they unfold they are thin and coated below with golden yellow persistent scales, and on the pale green upper surface with scattered whitish scales, and when fully grown are thick and coriaceous, dark green and lustrous above, from two to six inches long and from half an inch to nearly two inches broad, with stout midribs raised and rounded on the upper side, obscure often forked arcuate primary veins, and stout reticulate veinlets more conspicuous on the upper than on the lower surface; they are borne on stout grooved scurfy petioles from one quarter to one third of an inch in length, and, turning yellow at maturity, fall gradually at the end of their second or in their third year. The stipules are ovate, rounded or acute at the apex, brown and scarious,

[1] Kellogg, *Forest Trees of California*, 94.

[2] *Castanopsis chrysophylla*, β *minor*, A. de Candolle, *Prodr.* xvi. pt. ii. 110 (1864).

Castanea chrysophylla, var. *minor*, Bentham, *Pl. Hartweg.* 337 (1857).

Castanopsis chrysophylla, var. *pumila*, Vasey, *Rep. Dept. Agric. U. S.* 1875, 175 (*Cat. Forest Trees U. S.*) (1876).

puberulous, from one quarter to one third of an inch long, and caducous. The flowers mostly appear in summer, but also irregularly from June until February, in three-flowered clusters in the axils of broadly ovate apiculate pubescent bracts on staminate and androgynous scurfy stout-stemmed aments from two to two and a half inches in length and crowded at the ends of the branches, the pistillate clusters being solitary or in groups of two or three at the base of some of the lower aments. The calyx of the staminate flower is coated on the outer surface with hoary tomentum, and is divided into five or six broadly ovate rounded lobes much shorter than the slender stamens, which are inserted under the margin of a thin bright scarlet torus surrounding the minute tomentose abortive ovary. The calyx of the pistillate flower is oblong-campanulate, free from the ovary, clothed with hoary tomentum, divided at the apex into short rounded lobes, and rather shorter than the minute abortive stamens, which have red anthers; the ovary is conical, sessile on a thin torus, coated with pale hairs, and surmounted by three elongated slightly spreading stout pale stigmas. The fruit ripens during the second season; the involucres are then globose, dehiscent, irregularly four-valved, sessile, solitary, or often clustered, tomentose and covered on the outer surface by long stout or slender rigid sharp-pointed spines, and coated within with long pale hairs; they vary from an inch to an inch and a half in diameter, and contain one or occasionally two nuts which are broadly ovate, oblong, obtusely three angled, marked at the broad base by conspicuous umbilical scars and tipped at the apex with the stout remnants of the styles coated with pale tomentum; they are light yellow-brown and lustrous, with a thick shell of two coats, the outer being hard and bony and three or four times as thick as the inner, which is membranaceous, and lined with a dense coat of ferrugineous tomentum. The sweet and edible seed fills the cavity of the nut, and is covered with a thin dark purple-red membranaceous testa.

Castanopsis chrysophylla is distributed from the valley of the Columbia River southward along the western slopes of the Cascade Mountains, which it ascends to elevations of about four thousand feet above the level of the sea, along the western slopes of the Sierra Nevada, and through the California coast ranges to the elevated valleys of the San Jacinto Mountains.[1]

A small tree in Oregon and on the California Sierras, and usually shrubby at high elevations and on the California coast ranges south of the Bay of San Francisco, the golden-leaved Chestnut attains its greatest size and beauty in the humid climate of the coast valleys of northern California, where, scattered among coniferous trees, it is one of the noblest and most beautiful inhabitants of the forest, with its fluted columnar trunk and brilliant leaves, bright green and lustrous on the upper surface and golden yellow on the lower.

The wood of *Castanopsis chrysophylla* is light, soft, and close-grained, but not strong; it contains numerous obscure medullary rays and large open ducts marking with single rows the layers of annual growth. It is light brown tinged with red, with thin lighter colored sapwood composed of from fifty to sixty layers of annual growth. The specific gravity of the absolutely dry wood is 0.5574, a cubic foot weighing 34.74 pounds, and, like the bark, is exceedingly rich in tannin similar to that of the Oak.[2] In southern Oregon and northern California it is occasionally used in the manufacture of plows and other agricultural implements.

Castanopsis chrysophylla was discovered in 1830 by David Douglas[3] at the Cascades of the Columbia River, near the northern limits of its range. It was introduced into English gardens by Joseph Burke[4] before 1847, and is occasionally cultivated in European collections.[5]

[1] S. B. Parish, *Zoë*, iv. 346.

[2] Trimble, *Garden and Forest*, viii. 293.

[3] See ii. 94.

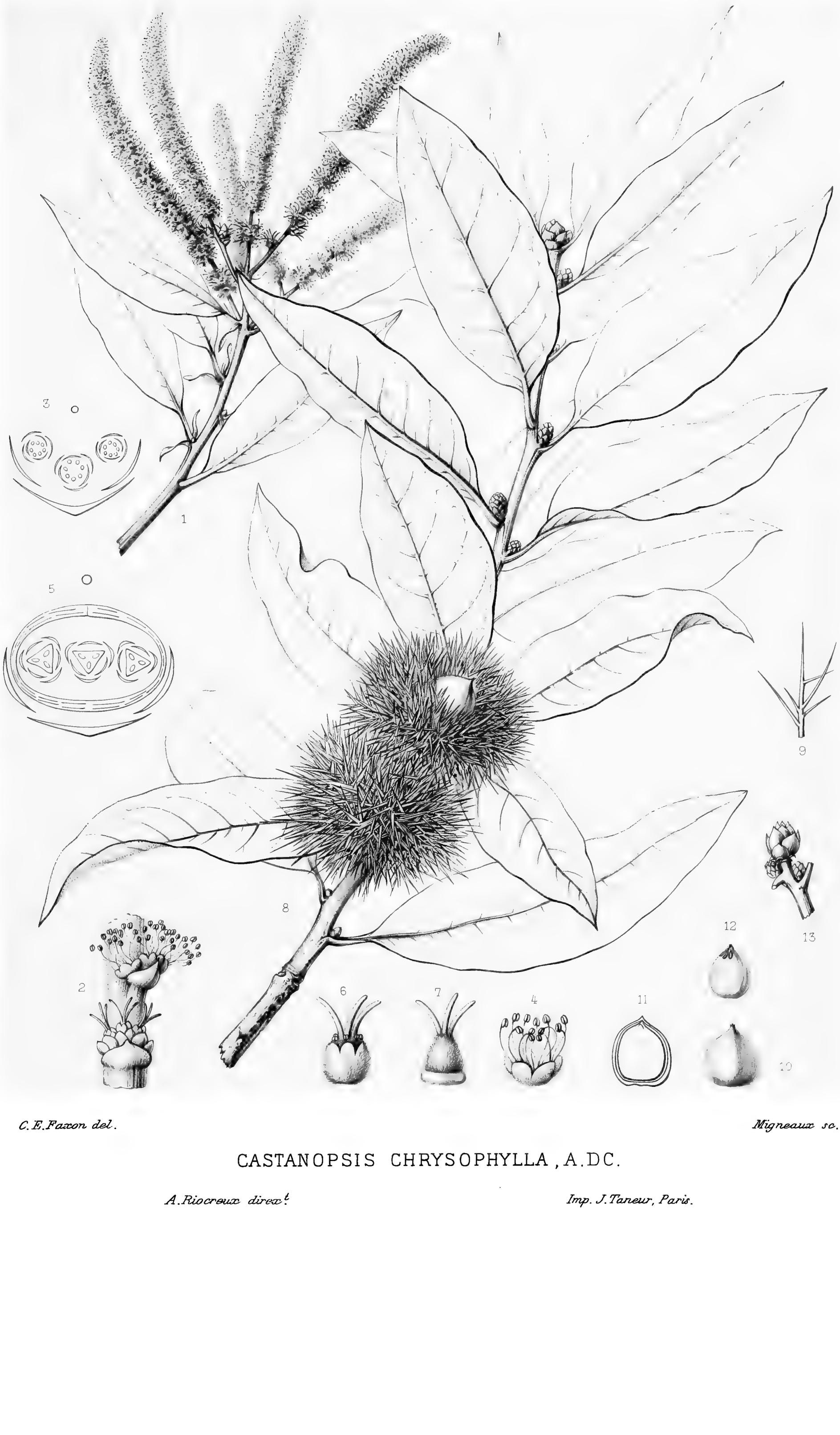
[4] Joseph Burke, a gardener of the Earl of Derby on his estate of Knowlsley, was sent by him to collect plants in south Africa in 1839. (See Hooker, *Lond. Jour. Bot.* ii. 163.) He returned to England in 1843, and in the following year was sent on a similar mission to northwestern America, where he probably remained until 1846 or 1847, as his correspondence with Sir William J. Hooker, preserved in the library of the Royal Gardens at Kew, shows that in November of the latter year he was in London. Of his subsequent career nothing is known. *Burkea*, a genus of south African woody plants, was dedicated to him by Hooker.

[5] *Gard. Chron.* n. ser. xiv. 435; ser. 3, xviii. 716.

EXPLANATION OF THE PLATE.

Plate CCCCXXXIX. Castanopsis chrysophylla.

1. A flowering branch, natural size.
2. Part of the base of an androgynous ament with staminate and pistillate flower-clusters, enlarged.
3. Diagram of a staminate inflorescence.
4. A staminate flower, enlarged.
5. Diagram of a pistillate inflorescence.
6. A pistillate flower, enlarged.
7. A pistillate flower with calyx and stamens removed, enlarged.
8. A fruiting branch, natural size.
9. An involucral spine, enlarged.
10. A nut, natural size.
11. Vertical section of a nut, natural size.
12. A seed, natural size.
13. Winter-buds, natural size.



C.E.Faxon del. *Migneaux sc.*

CASTANOPSIS CHRYSOPHYLLA, A.DC.

A.Riocreux direx.t *Imp. J.Taneur, Paris.*

CASTANEA.

Flowers unisexual, monœcious, apetalous, in erect unisexual and androgynous aments; calyx usually 6-parted or lobed, the divisions imbricated in æstivation; stamens 10 to 20; pistillate flowers included in an involucre of scale-like bracts; ovary inferior, 6-celled; ovules 2 in each cell, ascending. Fruit a nut inclosed in the accrescent spiny involucre. Leaves alternate, dentate, penniveined, stipulate, deciduous.

Castanea, Adanson, *Fam. Pl.* ii. 375 (1763). — Endlicher, *Gen.* 275. — Meisner, *Gen.* 346. — Baillon, *Hist. Pl.* vi. 257 (excl. sec. *Castanopsis* and *Callæocarpus*). — Bentham & Hooker, *Gen.* iii. 409. — Engler & Prantl, *Pflanzenfam.* iii. pt. i. 54 (excl. sec. *Castanopsis*).

Fagus, Linnæus, *Gen.* 292 (in part) (1737). — A. L. de Jussieu, *Gen.* 409 (in part).

Casanophorum, Necker, *Elem. Bot.* iii. 257 (1790).

Trees or shrubs, with astringent properties, watery juice, furrowed bark, porous brittle wood, terete branches, short ovate or oval acute buds formed in early summer,[1] covered with two pairs of slightly imbricated scales, those of the lower pair lateral, the others accrescent, becoming oblong-ovate and acute, and marking the base of the branch with narrow ring-like scars,[2] stout perpendicular tap-roots, and thick rootlets, producing, when cut, numerous stout shoots from the stump. Leaves convolute in the bud, ovate, acute, coarsely dentate with slender glandular teeth, penniveined, the slender veins running to the points of the teeth, petiolate, deciduous, leaving, when they fall, small elevated semioval leaf-scars marked with an irregular marginal row of minute fibro-vascular bundle-scars. Stipules ovate or linear-lanceolate, acute, scarious, infolding the leaf in the bud, caducous. Flowers monœcious, unisexual, anemophilous, strong-smelling, the staminate appearing with the first unfolding of the leaves on elongated simple deciduous aments from the inner scales of the terminal bud and from the axils of the lower leaves of the year, the pistillate scattered or spicate at the base of shorter persistent androgynous aments from the axils of later leaves.[3] Staminate flowers in from three to seven-flowered cymes in the axils of minute ovate bracts, the lateral flowers subtended by similar but smaller bracts. Calyx campanulate, pale straw-color, slightly puberulous, deeply divided into six ovate rounded segments imbricated in æstivation. Stamens from ten to twenty, inserted on the slightly thickened torus; filaments filiform, incurved in the bud, elongated, exserted, white; anthers ovoid or globose, pale yellow, attached on the back, introrse, two-celled, the cells parallel, contiguous, opening longitudinally. Ovary rudimentary, pilose, minute or wanting. Pistillate flowers sessile, two or three together or solitary, within a short-stemmed or sessile involucre of closely imbricated thick oblong acute bright green scales

[1] Castanea does not form a terminal bud, the end of the branch dying and dropping off at midsummer, leaving a small circular scar close to the upper axillary bud, which prolongs the branch the following season.

[2] Henry, *Nov. Act. Acad. Cæs. Leop.* xviii. 533, t. 40.

[3] The flowers on the unisexual aments are generally open when the stigmas of the pistillate flowers are in condition to receive their pollen, and these aments with the fading flowers usually fall from the branches before the opening of the staminate flowers on the androgynous aments, which does not occur until after the fecundation of the pistillate flowers.

There is some evidence that Castanea is not productive without cross-fertilization. Dr. J. Schneck (*Bot. Gazette*, vi. 159) found that several isolated planted Chestnut-trees near Mt. Carmel, Illinois, where the Chestnut is not indigenous, produced habitually large numbers of sterile involucres but no nuts. Trees in the same region in groups were prolific, while individuals not more than one mile from other Chestnut-trees produced a few nuts in the usually empty involucres. (See, also, Newby, *Gardener's Monthly*, xxvi. 145; xxvii. 20.) Mr. Thomas Meehan, on the other hand, believing (*Proc. Am. Assoc. Adv. Sci.* xix. 283; *Proc. Phil. Acad.* 1879, 166) that the staminate flowers wither and fall with the aments before the opening of the pistillate flowers, concluded that they were fertilized by pollen from the flowers above them on the androgynous spikes.

scurfy-pubescent or tomentose below the middle, subtended by a bract and two lateral bractlets. Calyx urceolate, its tube adnate to the ovary, the short limb divided into six obtuse lobes. Stamens minute, shorter than the calyx-lobes, sterile. Ovary inferior, six-celled after fecundation; styles six, linear, spreading, white, covered below with slender hairs, tipped by minute acute stigmas, exserted from the involucre; ovules two in each cell, attached on its inner angle, descending, semianatropous; micropyle superior. Fruit maturing in one season, its involucre containing from one to three nuts, globose or oblong, glabrous or tomentose and densely echinate on the outer surface with elongated ridged bright green ultimately brown branched spines fascicled between the deciduous scales, coated with pale tomentum on the inner surface, splitting at maturity into from two to four valves. Nut inclosed in the involucre, ovate, acute, crowned with the remnants of the styles, bright chestnut-brown and lustrous, tomentose or pubescent at the apex, cylindrical or, when more than one, flattened by mutual pressure, attached at the base by a large conspicuous pale circular or oval thickened umbilicus; perianth of two coats, the outer cartilaginous, the inner thicker and lined with pale tomentum. Seed solitary by abortion or rarely two or three, filling the cavity of the nut, marked at the apex by the abortive ovules, exalbuminous; testa membranaceous, light chestnut-brown; cotyledons thick and fleshy, more or less undulate-ruminate, sweet, farinaceous, hypogæous in germination; radicle minute, superior, inclosed between the cotyledons, the hilum basal, minute.

Castanea is now confined to the temperate regions of eastern North America, central and southern Europe, northern Africa, western Asia, and central and northern China and Japan. Four species are distinguished. The type of the genus, *Castanea Castanea*,[1] in various forms inhabits Europe, Africa,

[1] Karsten, *Pharm.-Med. Bot.* 495 (1882).

Fagus Castanea, Linnæus, *Spec.* 997 (1753). — Du Roi, *Harbk. Baumz.* i. 270. — Brotero, *Fl. Lusitan.* ii. 325.

Castanea sativa, Miller, *Dict.* ed. 8, No. 1 (1768). — Parlatore, *Fl. Ital.* iv. 170.

Castanea vulgaris, Lamarck, *Dict.* i. 708 (1783). — *Nouveau Duhamel*, iii. 66, t. 19. — A. de Candolle, *Prodr.* xvi. pt. ii. 114 (excl. var. γ). — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 246. — Boissier, *Fl. Orient.* iv. 1175. — Laguna, *Fl. Forestal Española*, pt. i. 203, t. 28.

Castanea vesca, Gærtner, *Fruct.* i. 181, t. 37 (1788). — Willdenow, *Spec.* iv. pt. i. 460. — Reichenbach, *Icon. Fl. German.* xii. 6, t. 640. — Hartig, *Forst. Culturpfl. Deutschl.* 150, t. 19. — Hempel & Wilhelm, *Bäume und Sträucher*, ii. 36, f. 142–144, t. 19.

An inhabitant of mountain forests in the temperate regions of Europe, the Chestnut grows spontaneously from Portugal to the shores of the Caspian Sea and as far north probably as the German Rhine-provinces and Belgium, although its cultivation has been practiced in Europe for so many centuries that it is not possible to fix with precision the area which it occupied before man recognized the value of its fruit as food and began to plant it. It grows, apparently naturally, on the mountains of Algeria near the borders of Tunis; but it is not impossible that the Chestnut-trees of Algeria, which do not form forests as do those on the mountains of southern Europe, were first carried to Africa by the Romans, who probably also introduced them into Great Britain, where the Chestnut is not believed to be indigenous (Barrington, *Phil. Trans.* xlix. 23. — Bentham, *Ill. Handb. Brit. Fl.* ii. 749), although in the southern counties of England it grows to a large size and attains a great age. The Tortworth Chestnut-tree on the estate of the Earl of Ducie, in Gloucestershire, which is still in a healthy condition, was remarkable for its great size in the reign of Stephen, who ascended the English throne in 1135, and is probably considerably more than a thousand years old. In 1776 the short trunk of this remarkable tree measured fifty feet in circumference at five feet above the ground. (See Strutt, *Sylva Britannica*, 17, t. 19.) This is probably the largest tree planted by man which is now living, unless, as some authors believe, the great Chestnut-trees on Mt. Etna in Sicily were planted (Philippi, *Linnæa*, vii. 743 [*Ueber die Vegetation am Aetna*]). The trunks of two of these Sicilian trees measure sixty-four and seventy feet in circumference; and at the end of the last century the low trunk of the Castagno dei Centi Cavalli, the largest of these trees, which owes its name to the popular and oft-repeated fable that John of Aragon with a hundred mounted followers once found protection under its broad and leafy crown, had a circumference of nearly two hundred feet at the surface of the ground. For centuries it had consisted of five separate pieces with an open space between them in the centre of which a small house had been built. (See Houel, *Voyage Pittoresque des Isles de Sicile, de Malte et de Lipari*, ii. 79, t. 114.) Subsequently two sections of the trunk disappeared, and a road now runs through what is left of this ancient tree. (See *Nature*, iv. 166.) Trees with trunks from twenty to thirty feet in circumference, and believed to be at least a thousand years old, are not uncommon in southern Europe, where the Chestnut is the largest and, with the exception perhaps of the Olive, the longest-lived inhabitant of the forest.

The wood of the European Chestnut is pale or sometimes nearly white, with dark brown heartwood, and contains numerous fine medullary rays and bands of large open cells marking the layers of annual growth. In construction it is not so durable as oak, yet in southern Europe chestnut-wood is largely used for building, for furniture and in cooperage, and is often grown in coppice to supply stakes for vineyards, hop-poles, and barrel-staves. It is as a fruit-tree, however, that the European Chestnut is most highly valued; and in Spain, France, and Italy, where chestnuts often form a large part of the food of the peasants, especially in the mountain districts of central France and northern Italy, attention is given to the selection and propagation of varieties with large well-flavored nuts. Olivier de Serres, early in the seventeenth century (*Théâtre de l'Agriculture*, 114), praised the Chestnut-trees which produced

and Asia; the other species are confined to the eastern United States; two of them are trees, and

the marrons of Lyons, and these still hold the first place among the varieties of the Chestnut. The best French marrons, or as they are called in the United States, Spanish chestnuts, are produced on the mountains of Provence, near Vivières, and in the neighborhood of Lyons, which, as the chief centre of distribution, has given them its name. At least fifty other varieties of the Chestnut are now distinguished by name in Europe, although different names are sometimes given to the same variety in different countries and provinces, and the number of really distinct cultivated varieties is probably not large. In the mountain districts of central and southern France and in Tuscany the Chestnut is cultivated on a large scale, orchards being established by planting in well prepared soil seedling trees which are grafted when five or six years old, usually by means of a ring graft, with the Marron. The trees, which are carefully pruned to keep them in shape and to insure their productiveness, begin to bear when ten or twelve years old, although they do not produce large crops before the age of forty or fifty years. The nuts are gathered as they fall and placed in deep trays arranged under the roofs of small huts, in which slow fires of green wood are kept burning until the nuts become dry and hard. They are then ground into flour, which is made into a thick porridge, — la polita of Limousin and Périgord, — or into thin cakes or a sort of bread; or when intended for export the nuts are slightly dried in the sun, and then packed in casks in sand. (See Parmentier, *Traité de la Châtaigne.* — Sequeira, *Mem. Econ. Acad. Sci. Lisboa*, ii. 295 [*Acerca da Cultura, e utilidade dos Castanheiros na Comarca de Portalegre*]. — Lamy, *Essai Monographique sur le Châtaigne.* — Decaisne et Naudin, *Manuel de l'Amateur des Jardins*, iv. 613. — Sousa Pimentel, *Pinhaes, Soutos e Montados*, pt. ii. — Spons, *Encyclopædia of the Industrial Arts, Manufactures, and Raw Commercial Products*, ii. 1352. — *Reports on the Cultivation of the Spanish Chestnut* [India Office, 1892].)

The European Chestnut was probably introduced into the United States by Eleuthère-Irénée du Pont de Nemours, a Frenchman who came to this country in 1799, and three years later established on the banks of the Brandywine, near Wilmington, Delaware, the gunpowder works which are still carried on by his grandchildren. Du Pont was deeply interested in horticulture and agriculture, and in 1805 planted the European Chestnut on his Delaware estate. The original trees are no longer alive, but their progeny is widely scattered through the middle states, where several named varieties, descendants of the Du Pont trees, are recognized. During recent years some attention has been paid to the cultivation of the European Chestnut in the United States, and small orchards of seedlings or grafted trees have been established in the middle Atlantic states, in Georgia, and in California. In New England it is not very hardy, and produces fruit but sparingly and in a few favored localities.

Varieties of *Castanea Castanea* with laciniately cut and divided leaves (var. *laciniata*), or with variously colored leaves (var. *variegata*), are sometimes cultivated in European gardens, although they are curious rather than handsome (Loudon, *Arb. Brit.* iii. 1984. — Dippel, *Handb. Laubholzk.* ii. 55).

The Chestnut-trees of China and Japan have been considered by some botanists as forms of the European species and by others as distinct species.

Of the distribution and properties of the Chinese tree comparatively little is yet known beyond the limits of its native land, where it appears to abound in the central and northern provinces. It is the *Castanea Bungeana* of Blume (*Mus. Bot. Lugd. Bat.* i. 284 [1850]), referred by Bunge (*Mém. Sav. Étr. St. Pétersbourg*, ii. 136 [*Enum. Pl. Chin. Bor.*]) and by A. de Candolle (*Prodr.* xvi. pt. ii. 114) to the European species. According to Bretschneider (*Jour. North China Branch Royal Asiatic Soc.* n. ser. xxv. 318 [*Botanicon Sinicum*, ii.]), who does not distinguish the Chinese from the European tree, the Chestnut is grown throughout the empire and is frequently mentioned in the Chinese classics. Abel, in 1816, found near the village of Tatung dwarf Chestnut-bushes, and their small fruit exposed for sale in the markets (*Narrative of a Journey in the Interior of China*, 165); and near Ningpo Fortune found two species or varieties cultivated on the hills. "One is somewhat like the Spanish, and, although probably a different variety, it produces fruit quite equal in quality, if not superior, to the Spanish chestnut. The other is a delicious little kind bearing fruit about the size and form of our common hazel nut." (*A Residence among the Chinese*, 51. See, also, Smith, *Chinese Mat. Med.* 60. — Soubeiran & Thiersant, *Mat. Méd. Chin.* 140.)

In Japan the Chestnut-tree is distributed from central Yezo, where it is not abundant, southward through the mountain forests of the other islands. When considered as a variety of the European Chestnut — the view now adopted by most botanists who have studied the Japanese flora — its name and synonymy are as follows:

Castanea Castanea, var. *pubinervis*.

Fagus Castanea, Thunberg, *Fl. Jap.* 195 (not Linnæus) (1784).

Castanea vesca, Blume, *Bijdr. Fl. Ned. Ind.* 524 (not Gærtner) (1825).

Castanea vesca, β *pubinervis*, Hasskarl, *Cat. Alt. Hort. Bog.* 73 (nomen nudum) (1844). — Siebold & Zuccarini, *Abhand. Akad. Münch.* iv. pt. iii. 224 (1846).

Castanea crenata, Siebold & Zuccarini, *l. c.* (1846).

Castanea stricta, Siebold & Zuccarini, *l. c.* 225 (1846).

Castanea Japonica, Blume, *Mus. Bot. Lugd. Bat.* i. 284 (1850). — Gray, *Mem. Am. Acad.* n. ser. vi. 406 (*On the Botany of Japan*). — Miquel, *Ann. Mus. Lugd. Bat.* i. 121.

Castanea vulgaris, ε *Japonica*, A. de Candolle, *Prodr.* xvi. pt. ii. 115 (1864). — Franchet & Savatier, *Enum. Pl. Jap.* i. 450.

Blume (*l. c.* 285) describes twelve varieties of his *Castanea Japonica*, distinguished principally by the form of the leaves and the amount of pubescence on their lower surface. These are reduced by A. de Candolle (*l. c.*) to four, which probably represent cultivated rather than wild types.

In the mountain forests of Hondo the Chestnut is abundant at elevations of about twenty-five hundred feet above the sea, scattered singly or in small groves, but never forming forests and rarely growing over thirty feet tall or producing a trunk more than a foot in diameter. It appears to be rarely planted in Japanese villages or in temple gardens and is not cultivated in orchards, although some attention must have been given to its improvement as a fruit-tree, for varieties bearing fruit two or three times larger than those of the common forms are abundant in different parts of the empire, where the chestnut is an important article of food. Large chestnuts gathered on the neighboring hills are exposed for sale in the shops of Aomori, the most northern city of Hondo; and still larger ones, equaling the best marrons in size and flavor and produced in the south, are sold in Kobe and Osaka, great quantities being annually sent to the United States (Sargent, *Forest Fl. Japan*, 69).

The leaves of the Japanese Chestnut are the favorite food of the Chestnut Spinner (*Caligula Japonica*, Butler), a wild Japanese Bombycid, whose cocoons are gathered and their threads used as woof in coarse fabrics (Rein, *Industries of Japan*, 210).

the third is a shrub [1] of the southern coast region. Before the middle tertiary period Castanea existed in northern Greenland, and in Alaska, where traces of the leaves and fruit of *Castanea Ungeri*,[2] Heer, have been distinguished; and impressions of the leaves of one and perhaps of two species found in the miocene rocks of Oregon,[3] and in those of the upper miocene of the Colorado parks, show that Castanea, which already existed in Europe in the cretaceous period,[4] once inhabited western North America, whence it has now disappeared.

Castanea produces brittle coarse-grained porous wood, very durable in contact with the soil, and rich in tannin,[5] and sweet farinaceous seeds, which are important articles of food in the countries of southern Europe and in China and Japan. In the United States an infusion of the leaves of Castanea finds a place in the American Pharmacopœia, and has been used with doubtful results in the treatment of whooping-cough,[6] and in homœopathic practice.[7]

In North America Castanea is not seriously injured by the attacks of insects [8] or fungal diseases.[9]

The Japanese Chestnut-tree is more precocious than the European variety, and often begins to bear fruit when only a few feet high. It has been introduced into the gardens of eastern North America, where several named varieties are recognized by gardeners, and where it is hardy and prolific as far north as eastern Massachusetts. It is also occasionally cultivated in California and in Europe.

[1] *Castanea alnifolia*, Nuttall, *Gen.* ii. 217 (1818); *Sylva*, i. 19, t. 6.

? Fagus pumila, var. *præcox*, Walter, *Fl. Car.* 233 (1788).

Castanea nana, Elliott, *Sk.* ii. 615 (1824). — Rafinesque, *New Fl.* iii. 83. — Nuttall, *Trans. Am. Phil. Soc.* n. ser. v. 168. — Kearney, *Bull. Torrey Bot. Club*, xxi. 261, t. 206.

Castanea pumila, β *nana*, A. de Candolle, *Prodr.* xvi. pt. ii. 115 (1864).

Castanea alnifolia is a shrub with stems rarely exceeding three feet in height, forming small thickets by means of stolons in sandy barrens in the neighborhood of the coast of the south Atlantic states, and in western Louisiana and southern Arkansas. From *Castanea pumila*, with which it grows in the same regions and has often been confounded, it is distinguished by its larger oval-lanceolate mostly obtuse leaves, dark green and lustrous on the upper surface and green and slightly pubescent or tomentose on the lower, and by its larger nuts, which usually ripen rather earlier in the season.

[2] *Fl. Arct.* ii. 470, t. 45, f. 1–3, t. 46, f. 8. — Lesquereux, *Rep. U. S. Geolog. Surv.* viii. 246, t. 52, f. 1, 3–7 (*Contrib. Fossil Fl. Western Territories*, iii.).

[3] Lesquereux, *l. c.* vii. 163 (*l. c.* ii.).

[4] Saporta, *Origine Paléontologique des Arbres*, 155. — Zittel, *Handb. Palæontolog.* ii. 429.

[5] The extract of Chestnut-wood, which contains from seven to eight per cent. of tannin, is largely used in the United States and Europe to correct the color of hemlock and other tanning materials, and to produce a black dye. It is principally prepared in the mountainous regions of the middle Atlantic states of North America, where it is an extensive and important industry, and in France. To obtain the extract the logs are cut into lengths of from four to five feet, the large ones are split, and they are then chipped or shaved across the grain into small pieces by machinery constructed for the purpose. The chips are boiled in open wooden vessels or in closed copper or iron boilers to extract the tannin, and the product is then evaporated in vacuum pans. (See Sheldon, *Am. Jour. Sci.* i. 312 [*The Application of Chestnut Wood to the Arts of Tanning and Dyeing*]. — Paul Nass, *Ueber den Gerbstoff der Castanea vesca.* — Trimble, *Jour. Franklin Inst.* cxxxii. 303; cxxxiv. 408; *The Tannins*, ii. 117.)

[6] Johnson, *Man. Med. Bot. N. Am.* 250. — *U. S. Dispens.* ed. 16, 380.

[7] Millspaugh, *Am. Med. Pl. in Homœopathic Remedies*, ii. 158, t. 158.

[8] Although the insects that prey upon Castanea in America have not been exhaustively studied, nearly seventy species are known to affect the living trees and wood (Packard, *5th Rep. Entomolog. Comm.* 343). Among the species which destroy the wood a large undetermined Coleopterous larva is sometimes found boring into the solid trunks. The beetles whose larvæ are also known to affect the Chestnut are *Arhopalus fulminans*, Fabricius, *Calloides nobilis*, Say, and *Callidium æreum*, Newman. The larvæ of various species of beetles live in the bark, or in the branchlets after these have died or become diseased. Lepidopterous borers sometimes attack the trunks, *Prionoxystus Robiniæ*, Peck, having been noticed on Chestnut-trees, which are believed to be injured also by the imported European *Zeuzera pyrina*, Fabricius. Insects living upon the leaves rarely do much injury to Chestnut-trees. Fall Web-worms, however, the larvæ of Tussock Moths, and of species of Datana, Apatela, and other moths are common upon them. *Eugonia subsignaria*, Hübner, has been reported as destroying forests of Hickories and Chestnuts in Georgia (*Rep. Dept. Agric. U. S.* 1880, 271). Leaf-miners, principally species of Lithocolletis, Tischeria, and Nepticula, are rather common on Chestnut-trees, and the leaves are also affected by such tree-hoppers as *Smilia Castaneæ*, Fitch, and by *Callipterus Castaneæ*, Fitch, and *Phylloxera Castaneæ*, Haldeman. The larvæ of weevils from eggs deposited in the ovary of the flower frequently destroy the nuts, *Balaninus caryatrypes*, Boheman, often devouring them, and they are also eaten by the grubs of *Balaninus rectus*, Say.

[9] The Chestnut in America probably suffers less from fungal diseases than other trees of the same family. In midsummer a fungus, described originally by Berkeley & Curtis as *Septoria ochroleuca*, and later by Cooke & Ellis under the name of *Cryptosporium epiphyllum*, sometimes produces on the leaves small yellowish brown well-defined spots which the Italian botanist Berlese considers identical with the Italian seccume, a disease produced by *Cylindrosporium castanicolum*, Berlese, although the injury, which has been noticed in several places, seems to be less serious than it is in Europe. The trunks and stumps of Chestnut-trees are favorite habitations for a number of species of large fungi, and it is on them and on the trunks of different species of Quercus that the three species of Fistulina known in the United States are found.

Chestnut-trees can be easily raised from seeds, which, however, lose their power of germination if allowed to become too dry,[1] and the varieties are propagated by grafting.

Castanea, the Chestnut-tree of the Romans and the pre-Linnæan botanists, was united by Linnæus with the Beech-tree in his genus Fagus.

The leaves of the Chestnut are attacked by several Mildews, and, although common on the leaves of several trees, *Phyllactinia suffulta*, Saccardo, is never so conspicuous as it is on the fallen Chestnut-leaves in the autumn.

[1] Cobbett, *Woodlands*, 193.

CONSPECTUS OF THE NORTH AMERICAN ARBORESCENT SPECIES.

Leaves oblong-lanceolate, long-pointed, green and glabrous on both surfaces; nuts 2 or 3 in each involucre, flattened . . . . . 1. C. DENTATA.

Leaves oblong, acute, silvery white and pubescent on the lower surface; nut solitary, cylindrical . . . . . 2. C. PUMILA.

CASTANEA DENTATA.

Chestnut.

LEAVES oblong-lanceolate, long-pointed, green and glabrous on both surfaces. Nuts 2 or 3 in the involucre, flattened.

Castanea dentata, Borkhausen, *Handb. Forstbot.* i. 741 (1800). — Sudworth, *Bull. Torrey Bot. Club*, xix. 152; *Rep. Sec. Agric. U. S.* 1892, 328.

Fagus Castanea, Wangenheim, *Beschreib. Nordam. Holz.* 90 (not Linnæus) (1781); *Nordam. Holz.* 47. — Schoepf, *Mat. Med. Amer.* 139. — Walter, *Fl. Car.* 233. — Castiglioni, *Viag. negli Stati Uniti*, ii. 239.

Fagus Castanea dentata, Marshall, *Arbust. Am.* 46 (1785).

Castanea vesca: Americana, Michaux, *Fl. Bor.-Am.* ii. 193 (1803). — Persoon, *Syn.* ii. 572. — Pursh, *Fl. Am. Sept.* ii. 624. — Nuttall, *Gen.* ii. 217. — Elliott, *Sk.* ii. 614. — Torrey, *Fl. N. Y.* ii. 195, t. 111. — Emerson, *Trees Mass.* 164; ed. 2, i. 187, t.

Castanea vesca, Willdenow, *Spec.* iv. pt. i. 460 (in part) (1805). — Desfontaines, *Hist. Arb.* ii. 500 (in part). — Michaux f. *Hist. Arb. Am.* ii. 156, t. 6 (not Gærtner). — Bigelow, *Fl. Boston.* 224. — Hayne, *Dendr. Fl.* 165 (in part). — Sprengel, *Syst.* iii. 856 (in part). — Rafinesque, *New Fl.* iii. 82. — Gray, *Man.* 417. — Darlington, *Fl. Cestr.* ed. 3, 270. — Chapman, *Fl.* 424. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 46.

Castanea Americana, Rafinesque, *New Fl.* iii. 82 (1836). — Nuttall, *Sylva*, i. 24*. — Spach, *Hist. Vég.* xi. 191. — Dietrich, *Syn.* v. 305. — K. Koch, *Dendr.* ii. pt. ii. 23. — Lauche, *Deutsche Dendr.* ed. 2, 289. — Mayr, *Wald. Nordam.* 177. — Dippel, *Handb. Laubholzk.* ii. 57. — Koehne, *Deutsche Dendr.* 122.

Castanea Americana, var. **angustifolia**, Rafinesque, *New Fl.* iii. 82 (1836).

Castanea Americana, var. **latifolia**, Rafinesque, *New Fl.* iii. 82 (1836).

Castanea vulgaris, γ **Americana**, A. de Candolle, *Prodr.* xvi. pt. ii. 114 (1864). — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 157.

Castanea sativa, var. **Americana**, Sargent, *Garden and Forest*, ii. 484 (1889). — Watson & Coulter, *Gray's Man.* ed. 6, 479.

A tree, occasionally one hundred feet high in the forest, with a tall straight columnar trunk three or four feet in diameter, or often, when uncrowded by other trees, developing a short trunk which in some exceptional individuals attains a diameter of ten or twelve feet, and which usually divides not far above the ground into three or four stout horizontal limbs forming a broad low round-topped head of slightly pendulous branches, frequently one hundred feet across. The bark of the trunk varies from one to two inches in thickness, and is dark brown and divided by shallow irregular often interrupted fissures into broad flat ridges separating on the surface into small thin closely appressed scales. The branchlets are slender, and when they first appear are somewhat angled, light yellow-green sometimes tinged with red, lustrous, slightly puberulous, and marked with many small oblong white lenticels; they soon become glabrous and gradually turn olive-green tinged with yellow, or brown tinged with green, and ultimately dark brown. The winter-buds are ovate, acute, and about a quarter of an inch long, and are covered with thin dark chestnut-brown scales scarious on the margins. The leaves are oblong-lanceolate, acute and long-pointed at the apex, and coarsely serrate except at the gradually narrowed wedge-shaped base; they unfold late in the spring, and are then puberulous on the upper surface and clothed on the lower with fine cobweb-like tomentum; at maturity they are thin and glabrous, dark dull yellow-green above and pale yellow-green below, from six to eight inches long and about two inches wide, with pale yellow midribs and primary veins and stout yellow slightly angled puberulous petioles half an inch in length, and often flushed, especially while young, with red. The stipules are ovate-lanceolate, acute, yellow-green, puberulous, and about half an inch long. Late in the autumn before falling the leaves turn a bright clear yellow. The flowers open late in June or early in July after the leaves have grown to their full size, and exhale a sweet heavy odor which is disagreeable to many

people. The aments of staminate flowers, when they first appear, are about half an inch long, and are green below the middle and bright red above; when fully grown they are from six to eight inches in length, with stout green puberulous stems covered from the base to the apex with crowded or sometimes below the middle with scattered flower-clusters. The androgynous aments are slender, puberulous, and from two and a half to five inches in length; near their base are scattered irregularly two or three glabrous two or three-flowered involucres of pistillate flowers, which are raised on stout peduncles sometimes nearly half an inch long, and are subtended by short broadly ovate bright green bracts and bractlets; they are about a third of an inch in length, and rather longer than broad when the flowers are expanded, their scales being scurfy-pubescent, especially on the lower surface near the base;[1] above these involucres of pistillate flowers are scattered clusters of staminate flowers; these are smaller than those on the staminate aments, and fall in fading from the persistent rachis, which continues to rise throughout the season above the short raceme of fruit. The involucres grow rapidly and attain their full size by the middle of August, when they are from two to two and a half inches in diameter, sometimes a little longer than broad, and often somewhat flattened at the apex, with walls coated on the inner surface with lustrous rufous pubescence, and glabrous and covered on the outer with crowded fascicles of long slender glabrous much-branched prickles; they begin to open with the first frost and, gradually shedding their nuts, fall from the branches irregularly late in the autumn or during the winter.[2] The nuts, which are usually much compressed, vary from half an inch to an inch in width and are usually rather broader than long, although ovate-oblong nuts twice as long as they are broad are not uncommon; they are coated at the apex with thick pale tomentum which often extends to the middle and occasionally nearly to the base of the nut, and when dry are frequently marked with dark longitudinal bands; the shell is lined with thick rufous tomentum, and the seed is very sweet.[3]

Castanea dentata is distributed from southern Maine to the valley of the Winooski River in Vermont, to southern Ontario[4] and along the southern shores of Lake Ontario to southeastern Michigan, southward to Delaware and southeastern Indiana,[5] and along the Alleghany Mountains to central Alabama and Mississippi, and to central Kentucky and Tennessee. Very common on the glacial drift of the northern states, where it grows rapidly to a large size and lives to a great age, it is rarely found on limestone soils, and, except at the north, does not range far beyond the Appalachian hills, upon which, in western North Carolina and eastern Tennessee, it attains its noblest dimensions.

The wood of *Castanea dentata* is light, soft, not strong, coarse-grained, liable to check and warp in drying, easily split, and very durable in contact with the soil. It is reddish brown, with thin lighter colored sapwood composed of three or four layers of annual growth, and contains numerous obscure medullary rays and bands of many rows of large open ducts marking the layers of annual growth. The specific gravity of the absolutely dry wood is 0.4504, a cubic foot weighing 28.07 pounds. It is largely used in the manufacture of cheap furniture and in the interior finish of houses, and for railway ties, fence-posts, and rails, its durability, due to the large amount of tannic acid which it contains, being its most valuable quality.

The nuts, which surpass those of the Old World Chestnut in sweetness and flavor, are gathered in great quantities in the forest, and are sold in all the markets of the eastern states.[6]

[1] On occasional individual trees the involucres of pistillate flowers replace the staminate flowers on the androgynous aments, either partly or entirely, and so become racemose. (See Martindale, *Proc. Phil. Acad.* 1880, 351.)

[2] A tree near Freehold in Greene County, New York, supposed to be from sixty to seventy years old, produces uniformly involucres that are reduced to a small torus-like cushion upon which the naked and unprotected nuts stand. These are well formed, but are never allowed by birds and squirrels to ripen.

[3] The American Chestnut, which many botanists have considered a geographical form of the Old World species, differs from the European tree in its thinner leaves, which are narrower and more cuneate at the base, in its better flavored and sweeter seeds, and in the thinner shell of the nut, and is best treated as a distinct species.

[4] Brunet, *Cat. Vég. Lig. Can.* 50. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 53°. — Macoun, *Cat. Can. Pl.* 443.

[5] Ridgway, *Proc. U. S. Nat. Mus.* v. 84.

[6] Little attention has yet been paid to improving by selection and cultivation the nuts of the American Chestnut. Of better flavor and larger size than those of the uncultivated forms of the European species, and with an equal tendency to variation, there is no reason why they should not be made to surpass the best varieties

The Chestnut attracted the attention of several early European travelers in America, and what is probably the first account of its fruit appears in the narrative of one of the followers of De Soto, published in 1609.[1] More than a century later it was described by Clayton in the *Flora Virginica*.[2]

Castanea dentata is one of the most useful and beautiful trees of the forests of eastern North America. No other tree grows so rapidly or to such a great size on the dry gravelly hills of the north-eastern states. Always beautiful with its massive trunk, its compact round-topped head, and slender dark green leaves, in early summer, long after the flowers of its companions have disappeared, the Chestnut covers itself with great masses of spikes of yellow flowers, and is then the most magnificent object in the sylvan landscape.[3]

of the fruit of that tree. In recent years in the middle states Chestnut-trees grown in the woods have been successfully grafted with varieties of the European Chestnut, and productive orchards have been established. (See *The Rural New Yorker*, liii. 661, 677, 693.)

[1] "Where there be Mountaines, there be chestnuts: they are somewhat smaller than the chestnuts of Spaine." (*Virginia richly valued. Written by a Portugall gentleman of Eluas, emploied in all the action, and translated out of Portuguese, by Richard Hakluyt*, 131 [Force, *Coll. Hist. Tracts*, iv. No. 1].)

"Chestnutt, of this sorte there is very greate plenty; the tymber whereof is excellent for building, and is a very good commodity, especially in respect of the fruit, both for man and beast." (Morton, *New English Canaan*, 44 [Force, *l. c.* ii. No. 5].)

"In some places we fynd chestnutts, whose wild fruict I maie well saie equallize the best in France, Spaine, Germany, Italy, or those so commended in the Black sea, by Constantinople, of all which I have eaten." (Strachey, *Historie of Travaile into Virginia Britannia*, ed. Major, 117, t.)

"The Indians have an Art of drying their chesnuts, and so to preserve them in their barnes for a daintie all the year." (Roger Williams, *A Key into the Language of America*, 90.)

"Chestnuts; very sweet in taste, and may be (as they usually are) eaten raw; the *Indians* sell them to the *English* for twelve pence a bushel." (Josselyn, *New England Rarities*, 97.)

[2] *Castanea fructu dulciori*, 118.

[3] *Garden and Forest*, iii. 359, f. — Rothrock, *Forest Leaves*, ii. 35, f.

EXPLANATION OF THE PLATES.

PLATE CCCCXL. CASTANEA DENTATA.

1. A flowering branch, natural size.
2. Diagram of a staminate flower-cluster.
3. Diagram of a pistillate flower-cluster.
4. A staminate flower, enlarged.
5. A stamen, front and rear views, enlarged.
6. A pistillate flower, enlarged.
7. Vertical section of a pistillate flower, enlarged.
8. Vertical section of an involucre of pistillate flowers, enlarged.

PLATE CCCCXLI. CASTANEA DENTATA.

1. A fruiting branch, natural size.
2. An involucral spine, enlarged.
3. A nut, natural size.
4. A nut, natural size.
5. Vertical section of a nut, natural size.
6. A seed, natural size.
7. End of a young branchlet with unfolding leaves, stipules, and partly grown aments.
8. A winter branch, natural size.
9. An axillary bud and leaf-scar, enlarged.

C.E. Faxon del.

Rapine sc.

CASTANEA DENTATA, Borkh.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

C. E. Faxon del.

Migneaux sc.

CASTANEA DENTATA, Borkh.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

CASTANEA PUMILA.

Chinquapin.

LEAVES oblong, acute, silvery white and puberulous on the lower surface. Nut solitary, cylindrical.

Castanea pumila, Miller, *Dict.* ed. 8, No. 2 (1768). — Lamarck, *Dict.* i. 709. — Michaux, *Fl. Bor.-Am.* ii. 193. — Willdenow, *Spec.* iv. pt. i. 461; *Enum.* 980; *Berl. Baumz.* ed. 2, 78. — *Nouveau Duhamel*, iii. 79. — Persoon, *Syn.* ii. 572. — Desfontaines, *Hist. Arb.* ii. 500. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 418. — Michaux f. *Hist. Arb. Am.* ii. 166, t. 7. — Aiton, *Hort. Kew.* ed. 2, v. 298. — Pursh, *Fl. Am. Sept.* ii. 625. — Rafinesque, *Fl. Ludovic.* 159; *New Fl.* iii. 83. — Nuttall, *Gen.* ii. 217; *Trans. Am. Phil. Soc.* n. ser. v. 168. — Hayne, *Dendr. Fl.* 165. — Elliott, *Sk.* ii. 615. — Spach, *Hist. Vég.* xi. 192. — Torrey, *Fl. N. Y.* ii. 196. — Audubon, *Birds*, t. 85. — Dietrich, *Syn.* v. 305. — Darlington, *Fl. Cestr.* ed. 3, 270. — Chapman, *Fl.* 424 (in part). — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 47. — A. de Candolle, *Prodr.* xvi. pt. ii. 115 (excl. *β nana*). — K. Koch, *Dendr.* ii. pt. ii. 24. — Lauche, *Deutsche Dendr.* ed. 2, 289. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 156. — Mayr, *Wald. Nordam.* 177. — Watson & Coulter, *Gray's Man.* ed. 6, 479. — Dippel, *Handb. Laubholzk.* ii. 58, f. 25. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 418 (*Man. Pl. W. Texas*). — Koehne, *Deutsche Dendr.* 122.

Fagus pumila, Linnæus, *Spec.* 998 (1753). — Du Roi, *Harbk. Baumz.* i. 275. — Wangenheim, *Beschreib. Nordam. Holz.* 136; *Nordam. Holz.* 57, t. 19, f. 44. — Moench, *Bäume Weiss.* 41. — Schoepf, *Mat. Med. Amer.* 140. — Castiglioni, *Viag. negli Stati Uniti*, ii. 239. — Abbot & Smith, *Insects of Georgia*, ii. 113, t. 57. — Stokes, *Bot. Mat. Med.* iv. 415.

Fagus Castanea pumila, Muenchhausen, *Hausv.* v. 162 (1770). — Marshall, *Arbust. Am.* 47.

Fagus pumila, var. **serotina**, Walter, *Fl. Car.* 233 (1788).

A round-topped tree, rarely fifty feet in height, with a short straight trunk from two to three feet in diameter, and slender spreading branches; or usually a shrub spreading into broad thickets by prolific stolons, with numerous intricately branched stout stems often only four or five feet tall. The bark of the trunk on large individuals varies from half an inch to nearly an inch in thickness, and is light brown tinged with red, slightly furrowed and broken on the surface into loose plate-like scales. The branchlets are slender, marked with numerous minute lenticels, and coated at first with pale tomentum, which soon begins to disappear, and during their first winter they are pubescent, or tomentose at the apex, and bright red-brown, becoming glabrous, lustrous, and olive-green or orange-brown during their second season, and then gradually darker. The buds are ovate or oval, and about an eighth of an inch long, and are clothed, when they first appear in summer, with thick hoary tomentum; during the winter they are red, and covered with pale scurfy pubescence, or are occasionally tomentose. The leaves are oblong-oval or oblong-obovate, acute at the apex, and coarsely serrate with slender rigid spreading or incurved teeth except at the gradually narrowed usually unequal and rounded or wedge-shaped base; when they unfold they are covered on the upper surface with pale caducous tomentum, tinged with a red color which increases in depth until they are half grown, and coated on the lower surface with thick snowy white tomentum, with the exception of their midribs and primary veins, which are clothed with long silvery white hairs; when half grown they are yellow-green and slightly puberulous above, and silvery pubescent below, and at maturity they are rather thick and firm in texture, bright yellow-green and lustrous on the upper surface, hoary and silvery pubescent on the lower, from three to five inches long, and from an inch and a half to two inches wide, and are borne on stout pubescent petioles flattened on the upper side, and from one quarter to one half of an inch in length. The stipules are light yellow-green, and pubescent on both surfaces, with margins infolded below the middle; those of the two lowest leaves are broad, ovate, and acute, and are covered at the apex with rufous tomentum; those of the later leaves are ovate-lanceolate, often oblique, and acute, and at the extremity of the branch sometimes linear. The leaves turn a dull yellow

color before falling in the autumn. The fragrant flowers open after the leaves are fully grown, from the end of May at the south to the end of June in the middle states. The catkins of staminate flowers appear with the unfolding of the leaves, and at first are about half an inch long, pubescent, green below, and bright red at the apex; when fully grown they are from four to six inches in length, with stout stems covered with hoary tomentum, and crowded or scattered flower-clusters. The androgynous aments are coated with silvery white tomentum, and are from three to four inches in length. The involucres are one-flowered, and are few and scattered at the base of the ament, or they are often spicate, and cover its lower half; they are sessile or short-stalked, coated, like the lower half of their glandular pubescent scales, with pale tomentum, marked with two deep red lateral spots, and about as long as their ovate acute light green puberulous bracts; the staminate flowers clustered toward the apex of the ament are rather smaller than those on the staminate ament. The fruiting involucres, when fully grown, are from an inch to an inch and a half in diameter, with thin walls coated on the inner surface with lustrous pale hairs, and are tomentose on the outer surface, and covered with crowded fascicles of slender spines tomentose toward the base, or with scattered clusters of stouter spines. The nuts, which fall late in September and in October, are ovate, cylindrical, rounded at the slightly narrowed base, gradually narrowed and pointed at the apex, which is more or less coated with silvery white pubescence, dark chestnut-brown, and very lustrous, from three quarters of an inch to an inch long, and one third of an inch broad, with a thin shell lined with a coat of lustrous hoary tomentum, and a sweet seed.

Castanea pumila inhabits dry sandy ridges, rich hillsides, and the borders of swamps, and is distributed from southern Pennsylvania[1] to northern Florida and the valley of the Neches River in Texas. Usually shrubby in all the region east of the Alleghany Mountains, the Chinquapin becomes truly arborescent west of the Mississippi River, and grows to its largest size in southern Arkansas and eastern Texas, where it is also more abundant than in other parts of the country.

The wood of *Castanea pumila* is light, hard, strong, coarse-grained, and very durable in contact with the ground. It is dark brown, with thin hardly distinguishable sapwood composed of three or four thick layers of annual growth, and contains numerous obscure medullary rays and bands of several rows of large open ducts marking the layers of annual growth. The specific gravity of the absolutely dry wood is 0.5887, a cubic foot weighing 36.69 pounds. It is used for fence-posts and rails, and for railway ties.

The sweet nuts are gathered in the forest and sold in the markets of western and southern cities.

Differing from the Old World Chestnut in its low stature and solitary cylindrical nuts, the Chinquapin was noticed by several of the early European travelers in America. Captain John Smith published the first account of it in 1612,[2] and it was described by Banister in his *Catalogue of Virginia Plants*, published by Ray in 1688.[3] The Chinquapin was one of the first American plants

[1] In Pennsylvania *Castanea pumila* is almost confined to the counties of Adams and York, where it is often common, although it crosses over the western slope of the South Mountain into Franklin and Cumberland, occurring on the Susquehanna a few miles south of the city of Harrisburg. (See Baird, *Literary Record and Journal Linn. Assoc. Penn. College*, i. 59 [*A Catalogue of the Trees and Shrubs of Cumberland County, Pennsylvania*].)

[2] "They haue a small fruit growing on little trees, husked like a Chestnut, but the fruit most like a very small acorne. This they call *Chechinquamins*, which they esteeme a great daintie." (Smith, *A Map of Virginia. With a Description of the Country*, 11.)

"In deliciis habent *Chechinquamins*, fructus exiguos, glandibus haud absimiles, nisi quod calicibus contineantur instar avellanarum." (Jan de Laet, *Nov. Orb.* 81.)

"They have a small fruict growing in little trees, husked like a chestnut, but the fruict most like a very small acron, this they call chechniquamins, and these, with chestnutts, they boile four or five houres, of which they make both broth and bread, for their chief men, or at their greatest feasts." (Strachey, *Historie of Travaile into Virginia Britannia*, ed. Major, 118.)

"The *Chincopin* Tree bears a Nut not unlike the *Hazle*, the Shell is softer: Of the Kernel is made *Chocolate*, not much inferiour to that made of the *Cacoa*." (Thomas Ashe, *Carolina or a Description of the Present State of that Country*, 7.)

[3] *Castanea pumila racemoso fructu parvo, in singulis capsulis echinatis unico, The Chinquapin*, Ray, *Hist. Pl.* ii. 1926. — Miller, *Dict.* No. 3.

Castanea pumilis, Virginiana, racemoso fructu parvo, in singulis capsulis echinatis, unico, Plukenet, *Alm. Bot.* 90. — Catesby, *Nat. Hist. Car.* i. 9, t. 9.

cultivated in England, where it was introduced by the Duchess of Beaufort[1] at the end of the seventeenth century.[2]

Castanea pumila is perfectly hardy as far north, at least, as eastern Massachusetts, and in the Arnold Arboretum it flowers, and ripens its fruit in profusion.

Castanea humilis, Virginiana, racemosa, fructu parvo in singulis capsulis echinatis unico, Duhamel, *Traité des Arbres*, i. 134.

Fagus foliis lanceolato-ovatis acute serratis, amentis filiformibus nodosis, Clayton, *Fl. Virgin.* 118. — Royen, *Fl. Leyd. Prodr.* 79.

Fagus humilis (*seu Castanea, pumila*) *racemosa fructu parvo; in capsulis echinatis, singulo*, Romans, *Nat. Hist. Florida*, 19.

[1] Mary Capel (1630 ?–1714), the daughter of the distinguished Royalist leader, Arthur, Lord Capel of Haddam, married first Henry, Earl of Beauchamp, and afterward the third Marquis of Worcester, who, in 1682, became the first Duke of Beaufort, and was more famous for the magnificence and hospitality of his house of Badmington at Chippenham, in Surrey, which he built and surrounded with gardens, than for constancy in politics. At Badmington the Duchess maintained a botanic garden in which several plants were cultivated for the first time in Europe. *Beaufortia*, a genus of Australian shrubs of the Myrtle family, was dedicated to her memory by Robert Brown.

[2] Aiton, *Hort. Kew.* iii. 361 (Fagus). — Loudon, *Arb. Brit.* iii. 2002, f. 1927, 1928.

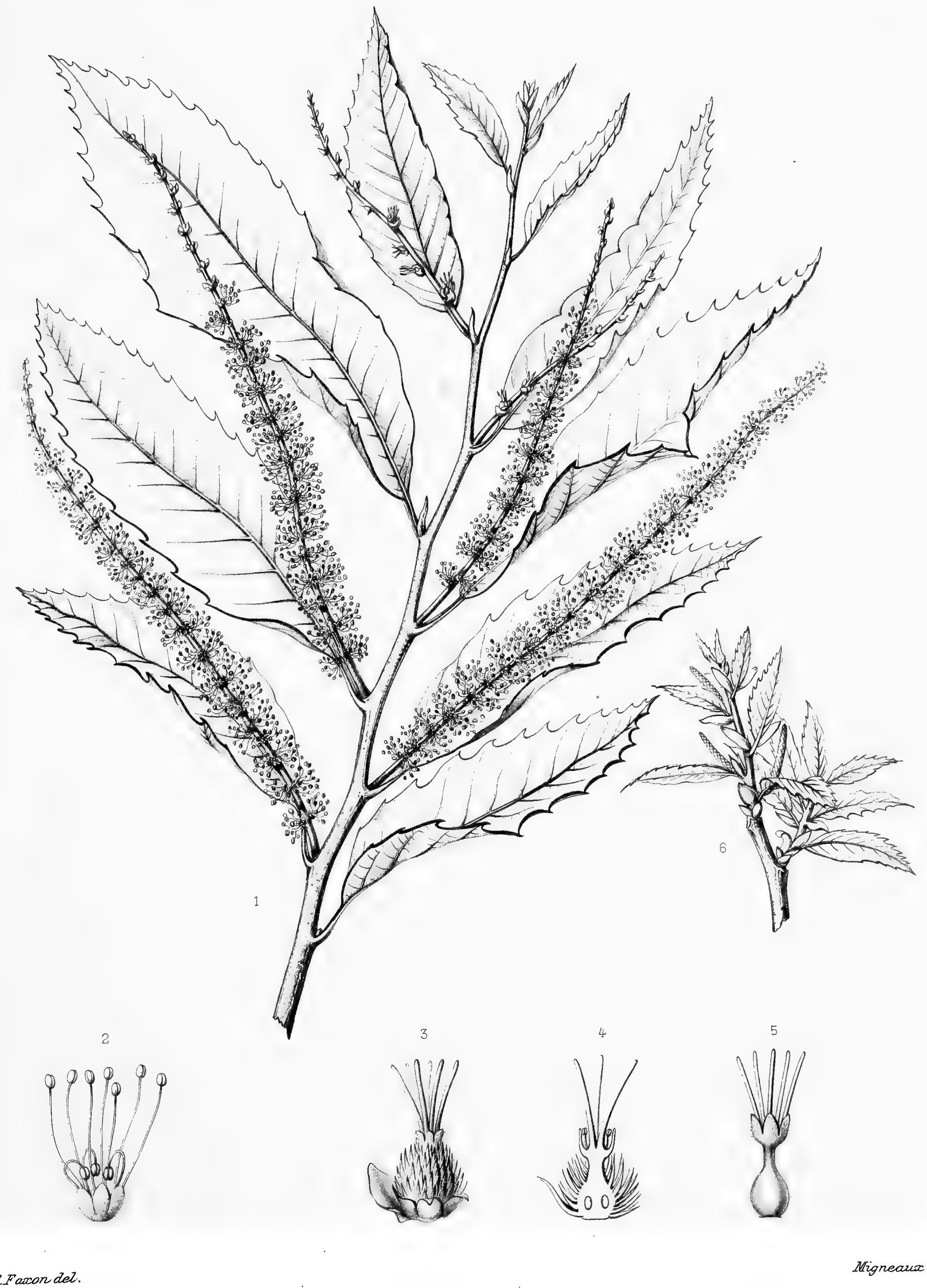
EXPLANATION OF THE PLATES.

Plate CCCCXLII. Castanea pumila.

1. A flowering branch, natural size.
2. A staminate flower, enlarged.
3. A pistillate flower in its involucre, enlarged.
4. Vertical section of a pistillate flower in its involucre, enlarged.
5. A pistillate flower, enlarged.
6. The end of a young branchlet with unfolding leaves and young staminate aments, natural size.

Plate CCCCXLIII. Castanea pumila.

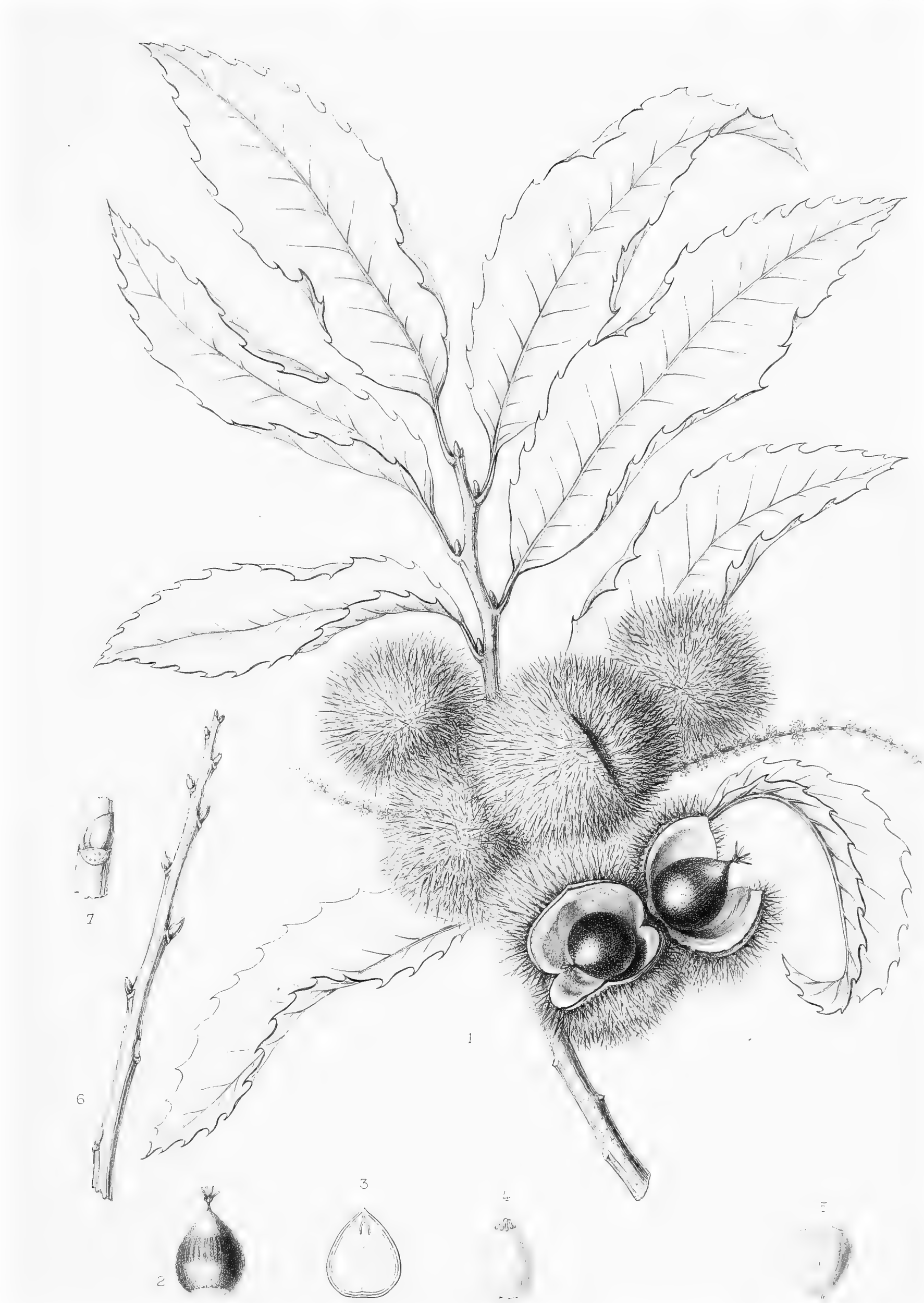
1. A fruiting branch, natural size.
2. A nut, natural size.
3. Vertical section of a nut, natural size.
4. A seed, natural size.
5. An embryo, natural size.
6. A winter branch, natural size.
7. An axillary bud and leaf-scar, enlarged.



C.E. Faxon del. Migneaux sc.

CASTANEA PUMILA, Mill.

A. Riocreux direx.t Imp. J. Taneur, Paris.



C.E. Faxon del. Rapine sc.

CASTANEA PUMILA, Mill.

A. Riocreux direx.t Imp. J. Taneur, Paris.

FAGUS.

FLOWERS unisexual, monœcious, apetalous, in unisexual clusters; calyx 4 to 7-lobed, the lobes imbricated in æstivation; stamens 8 to 40; pistillate flowers inclosed in an involucre of imbricated scale-like bracts; ovary inferior, 3-celled; ovules two in each cell, suspended. Fruit a nut inclosed in an echinate involucre. Leaves alternate, penniveined, stipulate, deciduous or persistent.

Fagus, Linnæus, *Gen.* 292 (in part) (1737). — A. L. de Jussieu, *Gen.* 409 (in part). — Endlicher, *Gen.* 275. — Meisner, *Gen.* 346. — Baillon, *Hist. Pl.* vi. 257. — Bentham & Hooker, *Gen.* iii. 410. — Prantl, *Engler & Prantl Pflanzenfam.* iii. pt. i. 53.

Nothofagus, Blume, *Mus. Bot. Lugd. Bat.* i. 307 (1850). — Prantl, *Engler & Prantl Pflanzenfam.* iii. pt. i. 52.

Lophozonia, Turczaninow, *Bull. Soc. Nat. Mosc.* i. 396 (1858).

Phegos, Saint-Léger, *Ann. Soc. Bot. Lyon*, vii. 133 (1880).

Trees or rarely shrubs, with watery juice, smooth close or deeply furrowed scaly bark, hard close-grained wood, slender terete branchlets, elongated scaly buds, thick roots often productive of numerous stems, and fibrous rootlets. Leaves alternate, penniveined, usually dentate, convex and plicate along the veins in vernation,[1] thick and firm, deciduous, leaving in falling small elevated semi-oval leaf-scars in which appear marginal rows of small fibro-vascular bundle-scars (Eufagus), or not plicate, small, coriaceous, persistent (Nothofagus). Stipules linear-lanceolate, infolding the leaf in the bud, fugacious or rarely persistent. Staminate flowers from the axils of minute bractlets or ebracteolate, fascicled in globose many-flowered heads on long drooping bibracteolate peduncles produced from the inner scales of the terminal bud and at the base of the shoots of the year or from the axils of the lowest leaves, or (Nothofagus) solitary or in from two to three-flowered clusters on short peduncles from the axils of the leaves of the year. Calyx subcampanulate, from four to seven-lobed, the lobes imbricated in æstivation. Stamens from eight to forty, inserted on the base of the calyx; filaments slender, filiform, exserted; anthers oblong, erect, attached on the back, introrse, obtuse or sagittate at the base, two-celled, the cells contiguous, opening longitudinally. Ovary wanting. Pistillate flowers in from two to four-flowered clusters, sessile, short-stalked, or rarely raised on elongated slender peduncles, in the axils of the upper leaves of the year, invested by numerous awl-shaped bractlets, the outer longer than the flowers and deciduous, the inner shorter and coherent at the base into four-lobed involucres. Calyx urceolate, its tube three-angled, adnate to the ovary, the short limb four or five-lobed. Staminodia wanting. Ovary inferior, three-celled; styles three, slender, recurved, pilose, exserted from the involucre, stigmatic toward the apex only, or short and often broad, stigmatic over the inner face (Nothofagus), ovules two in each cell, suspended from the apex of the inner angle, amphitropous; micropyle superior. Fruiting involucre woody, stalked or sessile, ovoid or subglobose, covered with variously shaped sometimes glandular prickles or tubercles, inclosing the from two to four nuts, ultimately splitting into four valves. Nut ovate, acute, unequally three-angled, the angles acute or winged, longitudinally ridged on the more or less concave sides, chestnut-brown and lustrous, tipped with the remnants of the styles, attached at the base by a small triangular umbilicus; pericarp thin, of two closely united coats, the outer crustaceous or subcoriaceous, the inner membranaceous. Seed solitary, filling the cavity of the nut, suspended with the abortive ovules from the tip of the hairy dissepiment of the ovary pushed by the growth of the seed into one of the angles of the nut, exalbuminous; testa membranaceous; cotyledons oily, thick and fleshy, plano-convex,

[1] Henry, *Nov. Act. Acad. Cæs. Leop.* xviii. 532, t. 40.

plicate and somewhat united, in germination epigæous, foliaceous and spreading; radicle minute, superior, exserted; hilum minute, apical.[1]

Fagus is now confined to temperate regions, where in the northern hemisphere it grows in eastern North America, over nearly the whole of Europe, on the mountains of Asia Minor and northern Persia, and in northern and central China and Japan, while in the southern hemisphere it inhabits the Chilian Andes, southern Patagonia, New Zealand, and the mountains of Australia. Fifteen or sixteen species are known;[2] one species inhabits eastern America, and one Europe,[3] western Asia, China, and Japan;[4] three are endemic to Australia;[5] four are found in New Zealand;[6] and five occur in the forests which spread over the mountains and cover the shores of southern Chili and Tierra del Fuego.[7] The type is

[1] By Bentham & Hooker (*Gen.* iii. 440) the species of Fagus are grouped in the following sections: —

EUFAGUS. Heads of staminate flowers globose, many-flowered, long-stalked; styles elongated, pilose, stigmatic on the inner face toward the apex only; young leaves plicate at the veins. Inhabitants of the northern hemisphere.

NOTHOFAGUS. Heads of staminate flowers 1 to 3-flowered, short-stalked or subsessile; styles short, often broad, stigmatic over the inner surface; young leaves not plicate. Inhabitants of western and antarctic South America, New Zealand, and Australia.

[2] A. de Candolle, *Prodr.* xvi. pt. ii. 117.

[3] *Fagus sylvatica*, Linnæus, *Spec.* 998 (1753). — Hornemann, *Fl. Dan.* viii. t. 1283. — *Nouveau Duhamel*, ii. 80, t. 24. — Smith & Sowerby, *English Bot.* xxvi. t. 1846. — Hartig, *Forst. Culturpfl. Deutschl.* 154, t. 20, t. 103, f. 6. — Reichenbach, *Icon. Fl. German.* xii. 6, t. 639. — A. de Candolle, *l. c.* 118. — Parlatore, *Fl. Ital.* iv. 165. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 247. — Boissier, *Fl. Orient.* iv. 1175. — Laguna, *Fl. Forestal Española*, pt. i. 194, t. 27. — Hempel & Wilhelm, *Bäume und Sträucher*, ii. 41, f. 145, 146, t. 20.

Castanea Fagus, Scopoli, *Fl. Carn.* ed. 2, ii. 242 (1772).

Fagus sylvestris, Gærtner, *Fruct.* i. 182, t. 37 (1788).

Fagus echinata, Gilibert, *Exercit. Phyt.* ii. 396 (1792).

Fagus sylvatica is one of the common forest trees of temperate Europe, where it is distributed from southern Norway and Sweden to the shores of the Mediterranean; it ascends the Swiss Alps to elevations of about five thousand feet above the sea-level, and in southern Europe is usually confined to high mountain slopes, often marking the upper limits of forest growth; it abounds in southern Russia and in the forests that cover the lower slopes of the mountains of the Caucasus, and is widely distributed in Asia Minor and the northern provinces of Persia. A large and fast-growing although not a long-lived tree, the Beech has been cultivated in Europe for more than three centuries, at first for the food which its sweet oily seeds afforded to deer and swine, and then as a timber-tree. Enduring a great amount of shade, it has been found a valuable tree to plant under Oaks and Pines in the forest. European foresters use it largely in this way, especially on limestone and chalky soils, in which the Beech grows with the greatest vigor, cutting it at the end of from eighty to a hundred years when its associates in the forests have not advanced more than half way to maturity (Burgsdorf, *Versuch Gesch. Holzart.* i. *Die Büche*).

The wood is gray tinged with red, and contains many small evenly distributed ducts and numerous often interrupted medullary rays which, on a vertical section, appear as shining plates. It is hard, close-grained, and moderately heavy, although not durable. Beech-wood makes excellent fuel and charcoal, and is also used for furniture, the handles of tools, the panels of carriages and the keels of boats, and for wooden shoes, which in some of the mountainous districts of central and southern Europe are made almost exclusively from this wood. Impregnated with sulphate of copper or other preservatives against attack, it has been used advantageously for railway ties (Mathieu, *Fl. Forestière*, ed. 3, 272).

Its broad crown and ample lustrous leaves, its smooth pale beautiful bark, and the delicate spray of its branchlets, make the Beech one of the most ornamental inhabitants of European woods and parks; and for more than a hundred years it has adorned the plantations of eastern America, where the Willows are the only European trees which have shown themselves better able to flourish in the severe climate of the northern states.

[4] *Fagus sylvatica*, var. δ *Sieboldi*, Maximowicz, *Bull. Acad. Sci. St. Pétersbourg*, xxxi. 101 (*Mél. Biol.* xii. 543) (1886).

Fagus ferruginea, Siebold, *Verh. Batav. Genoot.* xii. 25 (not Aiton) (1830).

Fagus Sieboldi, Endlicher, *Gen.* Suppl. iv. pt. ii. 29 (1847). — A. de Candolle, *l. c.* 119. — Franchet & Savatier, *Enum. Pl. Jap.* i. 451.

Fagus crenata, Blume, *Mus. Bot. Lugd. Bat.* i. 307 (1850).

Fagus sylvatica, γ *Asiatica*, A. de Candolle, *l. c.* 119 (1864). — Franchet & Savatier, *l. c.* 450.

In Japan the Beech, which is hardly distinguishable from the European tree, is one of the noblest inhabitants of the forest. It ranges from the shores of Volcano Bay in southern Yezo, where it grows nearly at the sea-level, southward over the mountains of the other islands. On those of central Hondo it is the most abundant of all deciduous-leaved trees, and one of the largest, often covering great areas lying between three and four thousand feet above the sea-level with pure forests or those in which it is mingled with Oaks, Chestnuts, and scattered Firs and Spruces. A second Beech with small leaves and small fruit borne on long slender peduncles, from the Hakone Mountains and the Province of Nambu, and described by Maximowicz (*l. c.*) as *Fagus Japonica*, has not been seen since it was first collected by Maximowicz's native servant, and is a doubtful species unknown to Japanese botanists.

In Japan the wood of the Beech is little esteemed or used, and the forests of this tree, which usually grow in comparatively inaccessible places, appear to be spreading rather than diminishing (Sargent, *Forest Fl. Japan*, 70).

[5] Hooker f. *Fl. Tasman.* i. 348. — Bentham, *Fl. Austral.* vi. 209.

[6] Hooker f. *Fl. New Zeal.* i. 229; *Handb. New Zeal. Fl.* 249.

[7] Mirbel, *Mém. Mus.* xiv. 465. — Hooker, *Jour. Bot.* ii. 153. — Hooker f. *Fl. Antarct.* ii. 345, t. 123, 124. — C. Gay, *Fl. Chil.* v. 387. — Philippi, *Linnæa*, xxix. 42.

The dense dark forests which cover the shores of the Straits of Magellan and the mountain slopes of Tierra del Fuego are principally composed of two Beech-trees, the Evergreen *Fagus betuloides* (Mirbel, *l. c.* 469, t. 25 [1827]. — Hooker f. *l. c.* 349, t. 124. — A. de Candolle, *Prodr. l. c.* 121) and the deciduous-leaved *Fagus antarctica* (Forster f. *Comm. Soc. Götting.* ix. 24 [1789]. — Hooker f. *l. c.* 345, t. 123. — A. de Candolle, *l. c.* 120).

Fagus betuloides "forms the prevailing feature of the scenery of

an ancient one. Well-defined traces of Fagus discovered in the cretaceous rocks of the Dakota group,[1] in the miocene of Alaska,[2] and in the auriferous gravels of California,[3] show that Beech-trees once inhabited those parts of the American continent from which they have now entirely disappeared; and in Europe several fossil species, principally of the miocene epoch, have been recognized, closely related, with a single exception,[4] to the Beeches which now inhabit the forests of the northern hemisphere.[5]

Fagus produces hard close-grained wood, and several species are important timber-trees, particularly those of Europe and North America, the South American *Fagus procera*[6] and *Fagus obliqua*,[7] the New Zealand *Fagus Menziesii*,[8] *Fagus fusca*,[9] *Fagus Solandri*,[10] and the Australian *Fagus Cunninghamii*.[11]

The sweet seeds of the European and American species are a favorite food of swine, which are turned into the forest to fatten upon them,[12] and in some parts of Europe oil is pressed from Beech-

Tierra del Fuego, especially in winter-time, from having persistent evergreen leaves, and from its upper limit being sharply defined and contrasting with the dazzling snow that covers the matted but naked branches of *Fagus antarctica*, which immediately succeeds it," and "which even at Cape Horn ascends much higher than *Fagus betuloides*, and nearly to the summit of the mountains which are a thousand feet below the line of perpetual snow, while at the sea-level it forms a larger tree" (Hooker f. *Fl. Antarct.* ii. 345. See, also, P. Parker King, *Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle*, i. 22, 37).

[1] Lesquereux, *U. S. Geolog. Rep.* vi. 67, t. 5, f. 6; *U. S. Geolog. Surv.* vii. 145, t. 19, f. 1–3; viii. 37 (*Contrib. Fossil Fl. W. Territories*, i., ii.). — Newberry, *Notes on the Later Extinct Flora of N. A.* 23.

[2] Heer, *Svensk. Vetensk. Akad. Handl.* ser. 4, viii. 30, t. 5, f. 4A; t. 7, f. 4–8, t. 8, f. 1 (*Fl. Foss. Alask.*).

[3] Lesquereux, *Mem. Mus. Comp. Zoöl.* vi. pt. ii. 3, t. 2, f. 13, 14 (*Fossil Plants of the Auriferous Gravel Deposits of the Sierra Nevada*).

[4] *Fagus pygmæa*, Unger, *Reise in Griechenland und in den jonischen Inseln*, 156, f. 6.

[5] Saporta, *Origine Paléontologique des Arbres*, 150. — Zittel, *Handb. Palæontolog.* ii. 425.

[6] Poeppig & Endlicher, *Nov. Gen. et Spec.* ii. 69, t. 197. — Hooker, *Jour. Bot.* ii. 154. — C. Gay, *Fl. Chil.* v. 387. — Philippi, *Linnæa*, xxix. 42.

[7] Mirbel, *Mém. Mus.* xiv. 465, t. 23 (1827). — Hooker f. *l. c.* 347, which grows at the level of the sea on the shores of the Straits of Magellan, replaces *Fagus antarctica* in southern Chili, ascending the western slopes of the Andes, where it is the principal forest tree below altitudes of five thousand feet.

[8] Hooker f. *Hooker Icon.* vii. t. 652 (1844); *Fl. New Zeal.* i. 229; *Handb. New Zeal. Fl.* 249. — A. de Candolle, *Prodr.* xvi. pt. ii. 122. — Kirk, *Forest Fl. New Zeal.* 175, t. 89.

The New Zealand Silver Beech is common in the mountainous regions of the Northern and Southern Islands, often forming extensive forests and sometimes growing a hundred feet tall, with a trunk from two to four feet in diameter covered with smooth silvery bark, and a symmetrical head of small persistent leaves. The wood is dark red, straight-grained, hard and dense, tough, elastic, and very strong, but not durable when exposed to soil or the elements. It is used in the interior construction of buildings, for furniture, and in cooperage.

[9] Hooker f. *Hooker Icon.* vii. t. 630, 631 (1844); *Fl. New Zeal. l. c.*; *Handb. New Zeal. Fl. l. c.* — A. de Candolle, *l. c.* — Kirk, *l. c.* 179, t. 91.

Fagus fusca, the New Zealand Black Beech, Bull Beech, or Red Beech, is the most widely distributed and important of the New Zealand Beeches, and probably the most valuable timber-tree of the genus. It is described as a tree more than one hundred feet high, with a trunk from two to ten feet in diameter, covered at maturity with deeply furrowed bright brown bark. In some mountain regions it forms nearly pure forests of great extent, and in others it is mixed with *Fagus Solandri* and *Fagus Menziesii*. The wood is red, strong, tough, and very durable in contact with the soil. It is valued for fence-posts, railway ties, and wharf-piles, and for all sorts of construction in which strength and durability are required (Kirk, *Reports on the Durability of New Zealand Timbers in Constructive Works*, 15).

[10] Hooker f. *Hooker Icon.* vii. 639 (1844); *Fl. New Zeal.* i. 230; *Handb. New Zeal. Fl.* 250. — A. de Candolle, *l. c.* — Kirk, *Forest Fl. New Zeal.* 91, t. 56.

Fagus Solandri is an evergreen tree which, in many parts of New Zealand, forms extensive forests. Occasionally rising to the height of one hundred feet, it is usually not more than seventy or eighty feet tall, with a trunk sometimes four feet in diameter. The wood is pale red or gray often streaked with black and handsomely figured. It is heavy, strong, and very tough, and durable if the tree is cut after it has reached maturity. It is used in construction, for fence-posts and rails, and for railway ties (Kirk, *Reports on the Durability of New Zealand Timbers in Constructive Works*, 17).

[11] Hooker, *Jour. Bot.* ii. 152, t. 7 (1840). — Hooker f. *Fl. Tasman.* i. 346. — A. de Candolle, *l. c.* — Bentham, *Fl. Austral.* vi. 210.

The Australian Myrtle or Evergreen Beech inhabits the mountains of Victoria, where it is not common, and Tasmania, where, growing with Eucalyptus and Atherosperma, it forms a large part of the dense dark forests which cover the western districts and the mountains, which it ascends to elevations of four thousand feet above the level of the sea. Growing sometimes two hundred feet tall and forming a trunk seven feet in diameter, it generally does not rise above a height of one hundred feet. The wood is hard and solid, richly colored, and often beautifully marked with a wavy grain. It is esteemed by the cabinet-maker, and is also used in the interior construction of houses and for the cogs of wheels (Maiden, *Useful Native Plants of Australia*, 535).

[12] "The kernels or mast within are reported to ease the paine of the kidneies proceeding of the stone if they be eaten, and to cause the grauell and sand the easier to come foorth: with these, mice and squirrels be greatly delighted, who do mightily increase by feeding thereon; swine also be fattened herewith, and certaine other beasts: also deere do feede thereon very greedily. They be likewise pleasant to thrushes and pigeons." (Gerarde, *Herball*, 1255.)

Animals are sometimes affected by the little known poison of Beech-nuts, which is believed to be confined to the shell, as flour

seeds.[1] Tar obtained by distillation from the wood of the European *Fagus sylvatica* is valued in the manufacture of creosote,[2] and has been used in the treatment of pulmonary diseases.[3]

The northern species of Fagus have long been used to decorate the parks and gardens of the United States and Europe, and many curious forms of the European Beech with colored or laciniately cut leaves, or with pendulous branches, have been multiplied by gardeners.[4]

In North America Fagus is generally exempt from the ravages of disfiguring insects[5] and destructive fungal diseases.[6]

made from the husked seeds is free from it. (See Cornevin, *Des Plantes Vénéneuse*, 137.) Tar of Beech-wood sometimes causes inflammation of the skin. (See J. C. White, *Dermatitis Venenata*, 147.)

[1] Beech-oil is manufactured in several European countries although principally in France, the forest of Compiegne being the chief seat of this industry. The ripe fruit is shaken down from the trees upon cloths spread to receive it, and is then sorted ; the best nuts are selected, slightly dried, and crushed to break the shells, which are removed from the mass by fanning ; the kernels are pounded in troughs into a paste which is put in a bag and subjected to pressure, and the oil which escapes is poured into broad pans and allowed to deposit the mucilaginous matter which it contains, and is then ready for use. About one gallon of oil is obtained from a bushel of nuts, and as much as twenty-two gallons have been obtained from a single tree. Beech-oil is of a clear yellow color and possesses a slight flavor. It is principally employed to adulterate olive-oil, and is sometimes used in cooking instead of butter, in the manufacture of soap, and for illuminating purposes. The refuse left after the extraction of the oil is made into coarse bread or serves as food for cattle (Spons, *Encyclopædia of Industrial Arts, Manufactures, and Raw Commercial Products*, ii. 1378. — *Kew Bull. Miscellaneous Information*, July, 1894, 218).

[2] Flückiger & Hanbury, *Pharmacographia*, 564.

[3] Baillon, *Traité Bot. Méd.* 1011.

[4] The most distinct and generally cultivated variety of *Fagus sylvatica* is the Purple or Copper Beech (*Fagus sylvatica foliis atro-rubentibus*, Muenchhausen, *Hausv.* v. 162 [1770]. — Du Roi, *Harbk. Baumz.* i. 268. *Fagus sylvatica*, β *purpurea*, Aiton, *Hort. Kew.* iii. 362 [1789]. — Loudon, *Arb. Brit.* iii. 1950). This tree is distinguished by deep red-purple or copper-colored leaves and purplish branchlets. Individual trees of this variety have appeared at different times in the forests of Europe. Wagner, in the *Historia Naturalis Helvetiæ Curiosa*, published in 1680, speaks of three Beech-trees with red leaves growing in a wood in Zurichgau. Twenty-six years later Scheuzer (*Beschreibung der Natur-Geschichten des Schweizerlandes*, pt. i. 2) gives a more detailed account of this tree, repeating the popular legend that the red-leaved Beech-trees sprang up in a forest where five brothers had murdered each other. A purple-leaved Beech derived from the trees of the forest of Buch was cultivated in a garden of the canton of Zurich before 1763, when Ott's *Dendrologie* was published ; on page 245 of this work this cultivated tree and the group of trees in the neighboring forest are mentioned. Most of the Purple Beeches now in cultivation, however, are probably derived from a tree of this variety discovered in the last century in the Hanleiter Forest near Sondershausen in Thuringia, which is supposed to be about two hundred years old and is still alive. (See Lutze, *Mittheilungen des Thuringer Botanischen Vereines*, 1892, pt. ii. 28 [*Zur Geschichte und Kultur der Blutbuchen*]. — Jäggi, *Gartenflora*, xlii. 150 [*Zur Geschichte der Blutbuche*]. — *Garden and Forest*, vii. 2 [*The Origin of the Purple Beech*].)

The Weeping Beech, a variety of *Fagus sylvatica*, with long pendulous branches which form a broad-based pyramidal tree, is also frequently planted; and several Beeches with pendulous branches differing slightly in habit are now propagated in nurseries. The first to attract attention appears to have been found in Great Britain, and Loudon (*l. c.* 1952) refers to individuals of this variety which were probably planted at the end of the eighteenth century.

The Fern-leaved or Cut-leaved Beech (*Fagus sylvatica, heterophylla*, Loudon, *l. c.* 1951, f. 1875, 1876), a form in which the leaves are more or less laciniately cut and divided, is also often found in collections of curious trees. It is probably of British origin, and has been cultivated for nearly a century.

[5] Although several species of insects feed on the Beech in North America, it is less seriously injured by them than many other American trees. The hymenopterous *Tremex Columba*, Linnæus, is common in the trunks, and several species of Coleoptera sometimes damage the stems and branches. *Goes pulverulentus*, Haldeman, bores into large branches and does considerable injury to the trees. Larvæ of species of Dicerca, Chrysobothris, and of other beetles are also frequently found in the trunk, although some of them do not attack the wood until it has begun to decay.

Among foliage-eating insects the Fall Web-worm is sometimes conspicuous on the Beech ; the Forest Tent-caterpillar, *Clisiocampa disstria*, Hübner, also occurs upon it ; and other species of leaf-eating Lepidoptera are frequent although not very abundant. The larva of *Eccopsis fagigemmæana*, Chambers, lives in a case formed of the bud-scales and feeds upon the leaves, and *Cryptolechia faginella*, Chambers, fastens the leaves together with silken threads. Plant-lice and scale insects belonging to such genera as Schizoneura and Aspidiotus are occasionally plentiful on the Beech, although more noticeable on cultivated trees than on those in the forest. The fruit is often infested by weevils.

[6] The North American Beech-tree is the favorite home of a large number of fungi. This is especially true of trees in northern and mountainous districts, where the fallen trunks are attacked by many characteristic species of great interest to mycologists. It cannot be said, however, that the Beech suffers in North America from any specific disease. It is one of the healthiest trees of the American forest, and the fungi which grow upon it are rather saprophytes than true parasites. *Scorias spongiosa*, Fries, which produces spongy excrescences often of considerable size, is not infrequently seen on its trunk. This fungus belongs to the group of species which are not strictly parasitic on the trees and shrubs upon which they are found, but follow the attacks of insects on whose excrescences or remains they grow ; but whether *Scorias spongiosa* grows on insect exudations or is really parasitic on the Beech itself has not yet been determined.

Of the many Pyrenomycetes found on Beech-trunks, *Hypoxylon turbinulatum*, Berkeley, is the most characteristic. It appears in the form of black cushions, so numerous that they are confluent at times and extend over the trunks in patches several feet long. *Nœmaspora crocea*, Persoon, is a common parasite, forming on the

Beech-trees can be easily raised from seeds, which should not be allowed to dry before they are planted, as they soon become rancid and lose their power of germination.[1] The varieties can be propagated by grafting.

Fagus, the classical name of the Beech-tree, was used by Tournefort,[2] and afterward adopted by Linnæus, who joined, however, in his genus the Chestnut-tree with the Beech.

surface of the branches small pustules from which exude yellowish gelatinous masses.

Of the Hymenomycetes which abound on Beech-trunks the most striking and common are *Agaricus adiposus*, Fries, which is abundant in the autumn, *Panus conchatus*, Fries, *Panus dorsalis*, Fries, *Phlehia radiata*, Fries, and the conspicuous and beautiful *Hydnum coralloides*, Scopoli, which forms variously branching masses sometimes as large as a human head, of a brilliant white color, with long depending teeth. *Onygena faginea*, Fries, is a characteristic and not uncommon fungus on the Beech; it grows on fallen trunks, appearing like small stalked puff-balls. The so-called Erineum of Beech-leaves, which is no longer considered a fungus, but merely a distortion of epidermal cells due to the attacks of Phytoptus, is the habitat of the fungus *Microsphæra erineophila*, Peck.

[1] Cobbett, *Woodlands*, 145.

[2] *Inst.* 584, t. 351.

FAGUS AMERICANA.

Beech.

LOBES of the calyx of the staminate flower short and rounded. Leaves oblong-ovate, coarsely dentate-serrate, deciduous.

Fagus Americana, Sweet, *Hort. Brit.* 370 (1826). — Spach, *Hist. Vég.* xi. 201.

Fagus Americana latifolia, Muenchhausen, *Hausv.* v. 162 (1770). — Wangenheim, *Nordam. Holz.* 80, t. 29, f. 55.

Fagus sylvatica, c Americana latifolia, Du Roi, *Harbk. Baumz.* i. 269 (1771).

Fagus sylvatica atro-punicea, Marshall, *Arbust. Am.* 46 (1785).

Fagus sylvatica, Schoepf, *Mat. Med. Amer.* 140 (not Linnæus) (1787). — Walter, *Fl. Car.* 233. — Castiglioni, *Viag. negli Stati Uniti*, ii. 239. — Pursh, *Fl. Am. Sept.* ii. 624. — Darlington, *Fl. Cestr.* ed. 2, 538.

Fagus ferruginea, Aiton, *Hort. Kew.* iii. 362 (1789). — Du Roi, *Harbk. Baumz.* ed. 2, i. 371. — Abbot & Smith, *Insects of Georgia*, ii. 149, t. 75. — Willdenow, *Berl. Baumz.* 112; *Spec.* iv. pt. i. 460; *Enum.* 980. — Persoon, *Syn.* ii. 571. — Desfontaines, *Hist. Arb.* ii. 496. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 416. — Michaux f. *Hist. Arb. Am.* ii. 174, t. 9. — Poiret, *Lam. Dict.* Suppl. iii. 49. — Bigelow, *Fl. Boston.* 224. — Pursh, *Fl. Am. Sept.* ii. 624. — Sprengel, *Syst.* iii. 856. — Hooker, *Fl. Bor.-Am.* ii. 159. — Torrey, *Fl. N. Y.* ii. 194, t. 110. — Darlington, *Fl. Cestr.* ed. 3, 271. — Chapman, *Fl.* 425. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 47. — A. de Candolle, *Prodr.* xvi. pt. ii. 118. — K. Koch, *Dendr.* ii. pt. ii. 19. — Lauche, *Deutsche Dendr.* ed, 2, 286. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 157. — Mayr, *Wald. Nordam.* 176. — Watson & Coulter, *Gray's Man.* ed. 6, 480. — Dippel, *Handb. Laubholzk.* ii. 53, f. 22. — Koehne, *Deutsche Dendr.* 121.

Fagus sylvestris, Michaux f. *Hist. Arb. Am.* ii. 170, t. 8 (1812). — Hooker, *Fl. Bor.-Am.* ii. 159.

Fagus alba, Rafinesque, *Fl. Ludovic.* 131 (1817); *New Fl.* iii. 80.

Fagus sylvatica, β Americana, Nuttall, *Gen.* ii. 216 (1818). — Elliott, *Sk.* ii. 613. — Loudon, *Arb. Brit.* iii. 1953. — Emerson, *Trees Mass.* 158; ed. 2, i. 180, t. (excl. staminate flower).

Fagus rotundifolia, Rafinesque, *Atlant. Jour.* 177 (*Florula Texensis*) (1833); *New Fl.* iii. 81.

Fagus heterophylla, Rafinesque, *New Fl.* iii. 80 (1836).

Fagus nigra, Rafinesque, *New Fl.* iii. 81 (1836).

Fagus ferruginea, latifolia, Loudon, *Arb. Brit.* iii. 1980, f. 1916 (1838).

Fagus ferruginea, Caroliniana, Loudon, *Arb. Brit.* iii. 1980, f. 1915 (1838).

Fagus atropunicea, Sudworth, *Bull. Torrey Bot. Club*, xx. 42 (1893); *Rep. Sec. Agric.* 1892, 328. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 418 (*Man. Pl. W. Texas*).

A tree, usually seventy or eighty, but under exceptionally favorable conditions occasionally one hundred and twenty feet in height, with a trunk three or four feet in diameter, often sending up from the roots numerous small stems, which sometimes form broad thickets around the parent tree. When crowded by other trees in the forest the Beech grows tall, with a long and comparatively slender trunk free of branches for more than half its length, and a narrow head; in open situations, where the branches have room for free lateral growth, it is short-stemmed, and the thick trunk divides into numerous limbs, which spread gradually, and form a broad compact round-topped head of slender slightly drooping branches beset with short lateral leafy branchlets. The bark of the trunk is compact and from one quarter to one half of an inch in thickness, with a smooth light steel-gray surface. The branchlets are slender, and when they first appear are pale green, and coated with long soft pale caducous hairs; during their first summer they are olive-green or orange-color, and conspicuously marked with oblong bright orange-colored lenticels, and, gradually growing red, they become bright reddish brown during their first winter, darker brown during their second season, and ultimately ashy gray. The buds are formed before the beginning of summer, when the growth of the year is completed, and are covered with numerous closely imbricated scales, increasing in length from the bottom of the bud upward; they are ovate, rather abruptly pointed, and puberulous, especially toward

the apex, during the summer, when they are not more than an eighth of an inch long; they lengthen in the autumn by the growth of the inner scales, and during the winter are from three quarters of an inch to nearly an inch long and about an eighth of an inch broad, and are gradually narrowed toward the base and the slender pointed apex; the scales are boat-shaped, thin, light chestnut-brown, and lustrous, and are often furnished at the apex, especially those on the upper part of the bud, with tufts of short pale hairs; the upper scales, which are clothed with pale hairs on the inner surface and along the margins, lengthen with the young branch, and when fully grown are often an inch long; they are thin, very lustrous, brown above the middle and suffused with red below, and fall before the scales of the outer ranks, marking the base of the branchlet with numerous narrow conspicuous persistent ring-like scars. The leaves stand rather remotely on the ends of the branches, and are clustered on the short lateral branchlets; they are plicately folded in the bud, oblong-ovate, acuminate with long slender points, and coarsely serrate with spreading or incurved triangular teeth, except at the gradually narrowed wedge-shaped rounded or cordate base; when the bud expands in very early spring they are pale green, and clothed on the lower surface and the margins with long pale lustrous silky hairs, which also cover the upper side of the midribs and veins; when fully grown they are at first light bright green, but soon grow darker, and at maturity are dull dark blue-green on the upper surface, light yellow-green and very lustrous on the lower surface, which is furnished with small tufts of long pale hairs in the axils of the veins, from two and a half to five inches in length and from one to three inches in breadth, with slender yellow midribs raised, rounded and covered with short pale hairs on the upper side, and slender primary veins impressed above, running obliquely to the points of the teeth, and connected by obscure reticulate veinlets; they are borne on short nearly terete slightly grooved hairy petioles from one quarter to one half of an inch long, and turn bright clear yellow in the autumn before falling. The stipules are ovate-lanceolate on the lower leaves and strap-shaped or linear-lanceolate on the upper, brown or often red below the middle, membranaceous, very lustrous, from an inch to an inch and a half in length, and caducous. The flowers open when the leaves are about one third grown. The staminate are borne in globose heads an inch in diameter on slender hairy peduncles produced from the axils of the inner bud-scales or of those of the lowest leaves, about two inches long, and furnished near the middle with linear-lanceolate hairy caducous bractlets sometimes a quarter of an inch in length. The calyx is subcampanulate, coated on the outer surface with pale hairs, gradually narrowed into a short pedicel, divided above the middle into short ovate rounded lobes, and not more than half the length of the stamens composed of white filaments and pale green anthers obtuse at the base. The pistillate flowers are borne in usually two-flowered clusters on short clavate peduncles from one half to three quarters of an inch long, coated with thick hoary tomentum, and produced from the axils of the upper leaves of the year; they are surrounded by an involucre of closely imbricated persistent scales clothed with long white hairs, and subtended by several deciduous pink bracts, increasing in size outward, the lowest being rather longer than the flowers, bright red and furnished at the apex with a tuft of white hairs, and nearly twice the length of the bract opposite to it. The lobes of the calyx, which is coated on the outer surface with pale hairs, are linear-lanceolate and acute, and rise about as high as the scales of the involucre. The stigmas are strongly reflexed, light green, and stigmatic on the inner face along the central line. The fruiting involucre is ovoid, thick-walled, about three quarters of an inch long, and is raised on a stout tomentose club-shaped peduncle from one quarter to three quarters of an inch in length; at midsummer, when it is fully grown, it is puberulous, dark orange-green, and covered with slender straight or slightly recurved prickles, red above the middle; in the autumn, at maturity, it is light brown, tomentose, and beset with strongly recurved pubescent prickles, and, opening with the first severe frosts, it remains on the branch after the nuts have fallen and often late into the winter. The nut is ovate, gradually narrowed to the rounded base, where it is marked by the small dark umbilical scar, acute at the apex, wing-angled, and longitudinally ridged between the wings, flattened on the inner surface, light chestnut-brown and

lustrous, and about three quarters of an inch long; the shell is crustaceous, and coated on the inner surface with appressed rufous tomentum which is thickest toward the apex. The sweet seed is covered by a dark red-brown coat.

Fagus Americana, although less common than several Oaks, is one of the most widely distributed trees of eastern North America, inhabiting the rich soil of uplands and mountain slopes, where it often forms nearly pure forests of considerable extent, and sometimes at the south the bottom-lands of streams and the margins of swamps. From the valley of the Restigouche River it ranges to the northern shores of Lake Huron [1] and northern Wisconsin, and southward to western Florida and through southern Illinois and southeastern Missouri to the valley of the Trinity River in Texas. The Beech attains its largest size in the forests which cover the rich intervale lands of the valley of the lower Ohio River,[2] on the slopes of the southern Alleghany Mountains, which it ascends nearly to their summits, and on the bluffs of the lower Mississippi, where, associated with the Evergreen Magnolia, it grows in great perfection.

The wood of *Fagus Americana* is hard, strong, tough, very close-grained, and susceptible of receiving a beautiful polish; it is not durable, however, in contact with the ground, and is difficult to season, being inclined to check badly in drying. It is dark or often light red, varying greatly in color in different localities,[3] with thin nearly white sapwood composed of from twenty to thirty layers of annual growth, and contains broad conspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.6883, a cubic foot weighing 42.89 pounds. It is largely used in the manufacture of chairs, shoe-lasts, plane-stocks, and the handles of tools, and for fuel.

The sweet nuts are gathered in the forest, and sold in the markets of Canada and of some of the western and middle states.

Confounded by early European travelers in America with the Beech-tree of the Old World, from which it differs in its paler bark and lighter green and more sharply serrate leaves, *Fagus Americana* was first distinguished by Clayton in the *Flora Virginica*, published in 1739.[4] It was cultivated in Europe soon after the middle of the eighteenth century,[5] and was first described from trees growing in German gardens.

The Beech, with its noble habit, its smooth pale bluish gray bark and its cheerful foliage, is one of the most beautiful inhabitants of the forests of eastern North America. It is delightful in early spring when the lengthening buds display the closely folded leaves between their delicate lustrous brightly tinted scales, and when, a few days later, it is covered with graceful drooping clusters of staminate flowers. The tender green of its vernal leaves enlivens the forest when the Oaks and Hickories are but just beginning to awaken from their winter slumbers; and the contrasts of light and shade, as the sun plays through its wide-spreading branches, increase its beauty when it is clothed with the deep green foliage of summer or with its brilliant yellow autumnal garment. But it is in winter, when the color of its bark is brightest, when the structure of its head is plainly seen, and the fine spray of its slender shining branchlets is thrown into clear relief against the sky, that the Beech displays its greatest beauty; and then the charm of this tree is unsurpassed by that of any other inhabitant of the forest or the park.[6]

[1] Brunet, *Cat. Vég. Lig. Can.* 50. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 52°. — Macoun, *Cat. Can. Pl.* 444.

[2] Ridgway, *Proc. U. S. Nat. Mus.* v. 85; *Bot. Gazette*, viii. 350.

[3] "Beech there is of two sorts, redd, and white very excellent for trenchers, or chairs and also for oares, may be accompted." (Thomas Morton, *New English Canaan*, 43 [*Force Coll. Hist. Tracts*, iii. No. 2].)

These different colored woods of the American Beech are produced by individual trees which are otherwise apparently identical, and have always been recognized by American lumbermen; and the younger Michaux and Pursh tried to find botanical characters by which the trees producing them could be distinguished.

[4] *Fagus vulgaris*, Clayton, *Fl. Virgin.* 118.

Fagus foliis ovatis obsolete serratis; fructu triangulo, Romans, *Nat. Hist. Florida*, 28.

[5] Aiton, *Hort. Kew.* iii. 362. — Loudon, *Arb. Brit.* iii. 1890, f. 1917.

[6] *Garden and Forest*, viii. 125, f. 19. — Rothrock, *Forest Leaves*, v. 40, f.

Easily raised from seed, and easily transplanted, the Beech is admirably suited to decorate the pleasure-grounds of our eastern states, where, however, it is as yet less commonly planted than the European species and its varieties.

EXPLANATION OF THE PLATE.

Plate CCCCXLIV. Fagus Americana.

1. A flowering branch, natural size.
2. Diagram of a pistillate inflorescence.
3. A staminate flower, enlarged.
4. Vertical section of a staminate flower, enlarged.
5. A cluster of pistillate flowers with their involucre, enlarged.
6. Vertical section of a cluster of pistillate flowers with their involucre, enlarged.
7. A pistillate flower, enlarged.
8. A fruiting branch, natural size.
9. A nut, natural size.
10. Vertical section of a nut, natural size.
11. Cross section of a nut, natural size.
12. A seed, with the hairy dissepiment attached at its apex and slightly separated below, and the abortive ovules, natural size.
13. An embryo, natural size.
14. A winter branch, natural size.
15. A leaf-scar, enlarged.
16. A seedling plant with cotyledons and young leaves, natural size.

C.E.Faxon del.

Mouriès sc.

FAGUS AMERICANA, Sweet.

A.Riocreux direx.t

Imp. J.Taneur, Paris.

OSTRYA.

Flowers unisexual, monœcious, apetalous, the staminate naked in long pendulous aments; stamens 3 to 14; the pistillate in erect lax aments; calyx denticulate, adnate to the inferior two-celled ovary, surrounded by a bract and two bractlets; ovule solitary in each cell, suspended. Fruit, a nut inclosed in a sack-like involucre formed from the accrescent bract and bractlets of the flower, and loosely imbricated into a strobile. Leaves alternate, stipulate, deciduous.

Ostrya, Scopoli, *Fl. Carn.* ed. 2, ii. 243 (1772). — Endlicher, *Gen.* 274. — Meisner, *Gen.* 346. — Bentham & Hooker, *Gen.* iii. 406. — Prantl, *Engler & Prantl Pflanzenfam.* iii. pt. i. 43.

Carpinus, Linnæus, *Gen.* 292 (in part) (1737). — Adanson, *Fam. Pl.* ii. 375 (in part). — A. L. de Jussieu, *Gen.* 409 (in part). — Baillon, *Hist. Pl.* vi. 255 (in part).

Small trees, with watery juice, scaly bark, hard close-grained wood, slender terete branchlets, elongated conical buds[1] formed in early summer and covered by numerous imbricated scales, those of the inner ranks accrescent and marking in falling the base of the branch with narrow ring-like scars, the lowest sterile, the upper the stipules of the first leaves, and fibrous roots. Leaves open and concave in the bud,[2] obliquely plicate along the primary veins, alternate, ovate, acute, doubly serrate, penniveined, the veins running obliquely to the points of the teeth, petiolate, deciduous, leaving in falling small semioval or crescent-shaped slightly oblique leaf-scars displaying the ends of three equidistant fibro-vascular bundle-scars. Stipules strap-shaped or obovate-oblong, scarious, infolding the leaf in the bud, caducous. Flowers appearing in early spring with the unfolding of the leaves, the staminate in long clustered pendulous aments developed in early summer from lateral buds near the ends of short lateral branchlets of the year, sessile or pedunculate, and naked and conspicuous during the winter, the pistillate in erect lax aments terminal on leafy branches of the year. Staminate flower composed of from three to fourteen stamens crowded on a pilose torus adnate to the base of a broadly ovate concave scale of the ament, which is rounded and abruptly contracted at the apex into a short point, ciliate on the margins and longer than the stamens; filaments filiform, abbreviated, two-branched near the apex, each branch bearing a one-celled erect oblong extrorse half-anther tipped with a cluster of long hairs, the cell opening longitudinally, or rarely undivided and bearing a two-celled anther. Pistillate flowers inclosed in hairy sack-like bodies formed by the union of a bract and two bractlets, and inserted in pairs on the base of the elongated ovate acute leafy ciliate scales of the ament persistent until midsummer, the lowest scales sterile. Calyx adnate to the ovary, dentate on the free narrow border. Ovary inferior, two-celled after fecundation, crowned with a short style divided into two elongated linear subulate spreading branches stigmatic on the inner face and exserted above the leafy scale; ovule solitary in each cell, suspended, anatropous, the micropyle superior. Fruiting involucres formed by the enlargement of the united bract and bractlets of the flowers, closed and flattened, bladder-like, ovate, acute, slightly unequal on the margins, pale, membranaceous, much longer than the nut, conspicuously longitudinally veined, reticulate-venulose, apiculate and hairy at the apex, hirsute at the base with sharp rigid stinging hairs,[3] imbricated into a short strobile fully grown at midsummer and

[1] Ostrya does not form a terminal bud, the end of the branch dying in summer and leaving during the winter a minute dark circular scar at the side of the upper axillary bud which prolongs the branch in the following spring (Foerste, *Bull. Torrey Bot. Club*, xx. 164, t. 148, f. 16).

[2] Henry, *Nov. Act. Acad. Cæs. Leop.* xviii. 530, t. 39.

[3] In handling a branch of Ostrya in summer and autumn the stiff sharp-pointed one-celled hairs which surround the base of the fruiting involucre become detached and, sticking into the flesh,

suspended on a slender bibracteolate peduncle. Nut ripening in autumn, ovate, acute, flattened, obscurely longitudinally ribbed, crowned with the remnants of the calyx, marked at the narrowed base with a small circular pale umbilicus; pericarp of two coats, the outer thin and membranaceous, the inner thicker, hard, and bony. Seed solitary by abortion, filling the cavity of the nut, suspended, exalbuminous, marked at the apex with the abortive ovule; testa membranaceous, light chestnut-brown; cotyledons thick and fleshy, plano-convex, epigæous in germination, much longer than the short superior radicle turned toward the minute hilum.

Four species of Ostrya are now known; two are North and Central American, one of them being widely distributed over the eastern part of the continent, while the other has been seen only on the upper slopes of the cañon of the Colorado River in Arizona; one species[1] inhabits southern Europe and western Asia, and the fourth is a native of northern Japan.[2] Traces of leaves and fruit discovered in the eocene and miocene rocks of Europe show that several species of Ostrya existed in Europe during the tertiary period, when it ranged as far north as Greenland;[3] at that time it inhabited the central mountainous part of the North American continent[4] and Japan,[5] and impressions of the leaves of what are believed to be the existing species of eastern America have been found in the yellow sandstones of southern New Jersey.[6]

Ostrya produces exceedingly hard close-grained wood, and bark rich in tannic acid.

In North America the genus is not seriously affected by insects[7] or fungal diseases.[8]

Plants of the different species can be easily raised from seeds, which usually do not germinate until the second year after they are sown.

produce in the case of some people an acute inflammation which does not entirely disappear for several hours.

[1] *Ostrya Ostrya* (not Macmillan).

Carpinus Ostrya, Linnæus, *Spec.* 998 (excl. hab. Virginia) (1753). — *Nouveau Duhamel*, ii. 200, t. 59.

Ostrya carpinifolia, Scopoli, *Fl. Carn.* ed. 2, ii. 244 (1772). — Reichenbach, *Icon. Fl. German.* xii. 5, t. 635. — A. de Candolle, *Prodr.* xvi. pt. ii. 125. — Parlatore, *Fl. Ital.* iv. 152. — Boissier, *Fl. Orient.* iv. 1178.

Ostrya vulgaris, Willdenow, *Spec.* iv. pt. i. 469 (1805). — Hartig, *Forst. Culturpfl. Deutschl.* 259, t. 22. — Hempel & Wilhelm, *Bäume und Sträucher*, ii. 35, f. 141, t. 18.

Ostrya Italica, Spach, *Ann. Sci. Nat.* sér. 2, xvi. 246 (1841); *Hist. Vég.* xi. 216.

The European Hop Hornbeam, which is scattered through the forest on low mountain slopes, is distributed from the coast region of southeastern France eastward through Italy, Sicily, southern Austria, Dalmatia, and the countries of southeastern Europe to northern Syria, Armenia, and Transcaucasia. It is sometimes cultivated as an ornamental tree in the gardens of western and central Europe, and has been introduced into those of the United States, where it is hardy as far north as eastern Massachusetts.

[2] *Ostrya Japonica*, Sargent, *Garden and Forest*, vi. 383, f. 58 (1893); *Forest Fl. Japan*, 66, t. 22.

Ostrya Virginica, Maximowicz, *Bull. Acad. Sci. St. Pétersbourg*, xxvii. 537 (*Mél. Biol.* xi. 317) (not Willdenow) (1881).

Nowhere abundant, the Japanese Hop Hornbeam inhabits with isolated individuals the forests of deciduous-leaved trees which cover central and southern Yezo, and occurs also in the province of Nambu in northern Hondo. Occasionally rising to the height of eighty feet, and forming a tall straight trunk eighteen inches in diameter, it is usually much smaller, with an average height of from twenty to thirty feet. Although very similar to the species of eastern America, the Japanese Hop Hornbeam differs from it in its thinner leaves and smaller strobiles, in the color of its bark, and in habit.

Ostrya Japonica was introduced in 1888 into the Arnold Arboretum by seed sent from Japan by Dr. H. Mayr, and has proved hardy in the climate of eastern Massachusetts.

Of the *Ostrya Mandshurica* of Budischtschew, included by Trautvetter in his *Incrementa Floræ Phœnogamæ Rossicæ* (*Act Hort. Petrop.* ix. 166), from the Transussurian districts of Manchuria, I have no knowledge. For geographical reasons it may be supposed identical with the Japanese species.

[3] Saporta, *Origine Paléontologique des Arbres*, 146. — Lesquereux, *Rep. U. S. Geolog. Surv.* vii. 142 (*Contrib. Fossil Fl. Western Territories*, ii.). — Zittel, *Handb. Palæontolog.* ii. 418.

[4] Lesquereux, *l. c.* viii. 151 (*l. c.* iii.).

[5] Nathorst, *Svensk. Vetensk. Akad. Handl.* xx. 42, t. 3, f. 2 (*Contrib. Fl. Foss. Jap.*).

[6] Hollick, *Bull. Torrey Bot. Club*, xix. 332.

[7] No injurious borers in the wood of Ostrya are recorded in North America. The Fall Web-worm is frequently seen on the leaves, which are also eaten by the larvæ of at least one of the American Silk Moths, *Telea Polyphemus*, Cramer. Leaf-miners are particularly common and often do serious injury to the foliage. *Lithocolletis ostryæfoliella*, Clemens, *Coleophora Ostryæ*, Clemens, *Aspidisca ostryæfoliella*, Clemens, *Nepticula ostryæfoliella*, Clemens, *Gracilaria ostryæella*, Chambers, and other species have been noted on the eastern tree. The fruit is often destroyed by a small weevil, or other insect with weevil-like habits, which in its larval stages lives within the nut.

[8] Of the fungi which attack Ostrya in America, nearly all are species found also on other trees. Only *Taphrina Ostryæ*, Ladebeck, which bears a striking resemblance to a closely related species found on Ostrya in Europe, need be alluded to here. It makes small patches of a deep purple color on the leaves in early summer without being specially injurious to the tree.

Ostrya, the classical name of the Hop Hornbeam, was adopted by Micheli[1] for these trees, which were afterward united by Linnæus with the Hornbeams in his genus Carpinus.

[1] *Nov. Pl. Gen.* 223, t. 104.

CONSPECTUS OF THE NORTH AMERICAN SPECIES.

Leaves oblong-lanceolate, acuminate or acute at the apex . . . . . 1. O. VIRGINIANA.

Leaves oval or obovate, acute or rounded at the apex . . . . . 2. O. KNOWLTONI.

OSTRYA VIRGINIANA.

Hop Hornbeam. Ironwood.

LEAVES oblong-lanceolate, acuminate or acute at the apex.

Ostrya Virginiana, K. Koch, *Dendr.* ii. pt. ii. 6 (1873). — Dippel, *Handb. Laubholzk.* ii. 139. — Koehne, *Deutsche Dendr.* 117. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 414 (*Man. Pl. W. Texas*).

Carpinus Ostrya, Linnæus, *Spec.* 998 (in part) (1753). — Wangenheim, *Beschreib. Nordam. Holz.* 137; *Nordam. Holz.* 48. — Marshall, *Arbust. Am.* 25. — Abbot & Smith, *Insects of Georgia*, ii. 151, t. 76. — Michaux f. *Hist. Arb. Am.* iii. 53, t. 7.

Carpinus Virginiana, Miller, *Dict.* ed. 8, No. 4 (1768). — Du Roi, *Harbk. Baumz.* i. 130. — Moench, *Bäume Weiss.* 19; *Meth.* 694. — Lamarck, *Dict.* i. 708. — Willdenow, *Berl. Baumz.* 53. — *Nouveau Duhamel*, ii. 201. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 413.

Carpinus Virginica, Muenchhausen, *Hausv.* v. 120 (1770). — Desfontaines, *Hist. Arb.* ii. 493.

Carpinus Ostrya: Americana, Michaux, *Fl. Bor.-Am.* ii. 202 (1803).

Ostrya Virginica, Willdenow, *Spec.* iv. pt. i. 469 (1805); *Enum.* 982; *Berl. Baumz.* ed. 2, 260. — Persoon, *Syn.* ii. 573. — Aiton, *Hort. Kew.* ed. 2, v. 302. — Pursh, *Fl. Am. Sept.* ii. 623. — Bigelow, *Fl. Boston.* 232. — Nuttall, *Gen.* ii. 219. — Hayne, *Dendr. Fl.* 169. — Elliott, *Sk.* ii. 618. — Sprengel, *Syst.* iii. 856. — Audubon, *Birds*, t. 40. — Hooker, *Fl. Bor.-Am.* ii. 160. — Spach, *Ann. Sci. Nat.* sér. 2, xvi. 246; *Hist. Vég.* xi. 218. — Torrey, *Fl. N. Y.* ii. 185, t. 102. — Emerson, *Trees Mass.* 177; ed. 2, i. 201, t. — Darlington, *Fl. Cestr.* ed. 3, 274. — Chapman, *Fl.* 426. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 75. — A. de Candolle, *Prodr.* xvi. pt. ii. 125. — Sargent, *Forest Trees N. Am.* 10th *Census U. S.* ix. 158. — Lauche, *Deutsche Dendr.* ed. 2, 284. — Watson & Coulter, *Gray's Man.* ed. 6, 474.

Zugilus Virginica, Rafinesque, *Fl. Ludovic.* 159 (1817).

Ostrya Virginica, α glandulosa, Spach, *Ann. Sci. Nat.* sér. 2, xvi. 246 (1841); *Hist. Vég.* xi. 218.

Ostrya Virginica, β eglandulosa, Spach, *Ann. Sci. Nat.* sér. 2, xvi. 246 (1841); *Hist. Vég.* xi. 218.

Ostrya Ostrya, Macmillan, *Metaspermæ of the Minnesota Valley*, 187 (1892).

A tree, occasionally fifty or sixty feet in height, with a short trunk two feet in diameter, but usually not more than twenty or thirty feet tall, with a trunk from twelve to eighteen inches thick. The branches are long and slender, and furnished with thin lateral branchlets, which spring from them at acute angles, and, spreading nearly at right angles with the stem, droop at their extremities and form a round-topped open head frequently fifty feet across. The bark of the trunk is rarely more than a quarter of an inch in thickness, and is broken into narrow thick oblong closely appressed plate-like light brown scales slightly tinged with red on the surface. The branchlets are slender, very tough, and marked with numerous pale lenticels, which lengthen horizontally as the branches increase in size, and remain for many years and until the bark becomes rough and scaly; when they first appear the branchlets are light green, and coated with pale hairs; at midsummer they are light orange-color and very lustrous, and during the first winter they are dark red-brown and lustrous, gradually growing darker brown, and losing their lustre in the following year. The buds are ovate, acute, a quarter of an inch long, and covered by loosely imbricated light chestnut-brown slightly puberulous ovate acute scales; those of the inner ranks lengthen slightly as the bud expands in early spring, and are green at the base and bright brown tinged with red toward the apex. The leaves are oblong-lanceolate, gradually narrowed into long slender points or acute at the apex, narrowed and rounded cordate or occasionally wedge-shaped at the base, which is often unequal, and sharply and doubly serrate with small triangular slender incurved callous teeth terminating at first in tufts of caducous hairs; when they unfold they are light bronze-green, glabrous above, and coated below on the midribs and primary veins with long pale hairs; and at maturity they are thin and extremely tough, dark dull yellow-green on the upper surface, light yellow-green and furnished with conspicuous tufts of pale hairs in the axils of the veins on the lower surface, from three to five inches long, and from an inch and a half to two

inches wide, with slender midribs impressed and puberulous above, and light yellow and pubescent below, and numerous slender veins usually forked near the margins; they are borne on slender nearly terete hairy petioles about a third of an inch long, and turn a clear yellow before falling in the autumn. The stipules are strap-shaped, concave, rounded and sometimes apiculate at the apex, ciliate on the margins with long pale hairs, hairy on the back, white and scarious, about half an inch long and an eighth of an inch broad, and caducous. During the winter the aments of staminate flowers, which first appear at midsummer, when they are coated with hoary tomentum, are about half an inch long, with light red-brown rather loosely imbricated scales, gradually narrowed into long slender points, and at the opening of the flowers in April at the south and early in June at the north, they are two inches long, with broadly obovate scales rounded and abruptly contracted at the apex into short points, ciliate on the margins with long pale hairs, green tinged with red above the middle, and light brown toward the base. The pistillate flowers open rather later than the staminate, and are borne in slender aments about a quarter of an inch long and raised on thin hairy peduncles; the scales of the ament are lanceolate, acute, light green, and often flushed with red above the middle; they are furnished at the apex with tufts of pale hairs, and decrease in size from the lowest, which is nearly half an inch long. The strobile of fruit is from an inch and a half to two inches in length, and from two thirds of an inch to nearly an inch in width, and is borne on a slender hairy stem nearly an inch long and marked with the scars left by the lower leafy sterile scales of the flowering ament and by the bractlets. The nuts ripen in the autumn, and are a third of an inch long, about an eighth of an inch wide, rather abruptly narrowed below the apex, and much flattened.

Ostrya Virginiana usually grows on dry gravelly slopes and ridges, often in the shade of Oaks, Maples, and other larger trees, and is distributed from the Island of Cape Breton and the shores of the Bay of Chaleur, through the valleys of the St. Lawrence and the lower Ottawa rivers, and along the northern shores of Lake Huron to western Ontario,[1] northern Minnesota, the Black Hills of Dakota,[2] eastern and northern Nebraska[3] and eastern Kansas,[4] and southward to northern Florida[5] and eastern Texas.[6] Very common in all this region, it appears to be most abundant and to grow to its largest size in southern Arkansas and the adjacent parts of Texas.

The wood of *Ostrya Virginiana* is heavy, very strong and hard, tough, exceedingly close-grained, durable in contact with the soil, and susceptible of receiving a beautiful polish; it contains numerous obscure medullary rays, and is light brown tinged with red, or often nearly white, with thick pale sapwood composed of from forty to fifty layers of annual growth. The specific gravity of the absolutely dry wood is 0.8284, a cubic foot weighing 51.62 pounds. It is used for fence-posts and many small articles like levers, the handles of tools, mallets, and in homœopathic practice.[7] The bark is rich in tannin, resembling that of Oak-bark, but probably is not often used commercially.[8]

Ostrya Virginiana was first described by Plukenet[9] in 1691 from a plant in Bishop Compton's[10] garden at Fulham, near London, which had been raised from seed sent from Virginia by the English missionary, John Banister.

Ostrya Virginiana owes its common name to the clusters of fruit that hang from its branches in summer and autumn and resemble those of the Hop-vine; it is a handsome shapely tree, with its

[1] Brunet, *Cat. Vég. Lig. Can.* 51. — Macoun, *Cat. Can. Pl.* 439.

[2] Williams, *Bull.* No. 43, *South Dakota Agric. Coll.* 107.

[3] Bessey, *Rep. Nebraska State Board Agric.* 1894, 110.

[4] Mason, *Eighth Bienn. Rep. State Board Agric. Kansas*, 271.

[5] *Ostrya Virginiana* was found by Mr. A. H. Curtiss in dry woods near Jacksonville, Florida, in the spring of 1894.

[6] The Ostrya from southern Mexico and Guatemala referred to this species (Hemsley, *Bot. Biol. Am. Cent.* iii. 166) I have not seen. It is not impossible that it may be the Arizona species.

[7] Millspaugh, *Am. Med. Pl. in Homœopathic Remedies*, ii. 159, t. 159.

[8] Trimble, *Garden and Forest*, viii. 293.

[9] *Carpinus Virginiana florescens, Phyt.* t. 156, f. 1. — Miller, *Dict.* No. 4. — Duhamel, *Traité des Arbres*, i. 128.

Aceris cognata Ostrya dicta, florescens, Virginiana, Plukenet, *Alm. Bot.* 7.

Carpinus squamis strobilorum inflatis, Clayton, *Fl. Virgin.* 118 (not Linnæus, *Hort. Clif.* 447).

Carpinus Americana, lupuli fructu, Royen, *Fl. Leyd. Prodr.* 537.

[10] See i. 6.

beautiful scaly bark, its dark leaves, and its broad head of slender lustrous pendulous branches presenting broad flat surfaces of yellow-green foliage, which form in the sunshine effective masses of light and shadow.

The Hop Hornbeam grows with comparative rapidity,[1] especially in good soil; it is very hardy, and is not seriously defaced by fungal or insect enemies, and its branches and leaves are so tough that winds rarely injure them. It is an excellent tree, therefore, to use along the margins of groups of Oaks and other deciduous-leaved trees in the parks of eastern America, or to plant on hilltops and in all exposed situations.

[1] The log specimen of *Ostrya Virginiana* in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, collected in northern New York, is twelve inches in diameter inside the bark, with seventy-six layers of annual growth, seven of which are of sapwood.

EXPLANATION OF THE PLATE.

PLATE CCCCXLV. OSTRYA VIRGINIANA.

1. A flowering branch, natural size.
2. A scale of the staminate ament, rear view, enlarged.
3. A staminate flower with its scale, front view, enlarged.
4. A stamen, enlarged.
5. Diagram of a pistillate inflorescence.
6. Pistillate flowers with their scale, front view, enlarged.
7. A pistillate flower inclosed in its bract and bractlets, enlarged.
8. A pistillate flower with its bract and bractlets laid open, enlarged.
9. A fruiting branch, natural size.
10. A fruiting involucre, natural size.
11. Vertical section of a fruiting involucre, showing the nut, natural size.
12. Vertical section of a nut, enlarged.
13. A seed, enlarged.
14. An embryo, enlarged.
15. A winter branch with staminate aments, natural size.
16. A leaf-scar, enlarged.

C.E.Faxon del. *Monziès sc.*

OSTRYA VIRGINIANA, K. Koch.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*

OSTRYA KNOWLTONI.

Ironwood.

LEAVES oval or obovate, acute or rounded at the apex.

Ostrya Knowltoni, Coville, *Garden and Forest*, vii. 114, f. 23 (1894).

A tree, from twenty to thirty feet in height, with a trunk from twelve to eighteen inches in diameter at the base and usually divided a foot or two above the ground into three or four stout upright stems four or five inches thick, and slender pendulous often much contorted branches forming a narrow round-topped symmetrical head. The bark of the trunk is an eighth of an inch thick and separates into loose hanging plate-like scales light gray and slightly tinged with red, from one to two feet in length and an inch or two in width, which, in separating, disclose the bright orange-colored inner bark. The branchlets are slender, and when they first appear are dark green and coated with hoary tomentum; during their first summer they are dark red-brown, marked with minute pale lenticels, and covered with pale pubescence; in their first winter they are light cinnamon-brown, glabrous and lustrous, and, growing lighter colored during the summer and autumn, they become ashy gray the following year. The leaves are oval or obovate, acute or rounded at the apex, gradually narrowed and often unequal at the rounded wedge-shaped or rarely cordate base, and sharply or often doubly serrate with small triangular teeth ending in stout spreading callous tips; when they unfold they are covered with loose pale tomentum, which is thicker on the lower surface, and at maturity they are dark yellow-green and pilose above, pale and soft-pubescent below, from one to two inches long and from an inch to an inch and a half wide, with slender yellow midribs slightly raised on the upper side, and few slender primary veins connected by obscure reticulate veinlets, and occasionally forked near the margin; they are borne on slender nearly terete hairy petioles from a quarter of an inch to nearly half an inch in length, and turn a dull yellow in the autumn before falling. The stipules are oblong-obovate, pale yellow-green, and often tinged with red toward the apex, half an inch long, about an eighth of an inch wide, and caducous. The aments of staminate flowers appear in July, and at first are coated with thick hoary tomentum; they are raised on stout peduncles clothed with rufous tomentum and sometimes nearly half an inch in length, or occasionally are sessile or nearly sessile, and during the winter are about half an inch long, with dark brown puberulous scales gradually contracted into long slender subulate points; they lengthen in May, and when fully grown are from an inch to an inch and a quarter in length, with broadly ovate concave scales rounded and abruptly narrowed at the apex into nearly triangular points, yellow-green near the base and bright red above the middle. The pistillate aments are about a quarter of an inch long, with ovate lanceolate light yellow-green puberulous scales ciliate on the margins. The strobile of fruit, which is fully grown by the first of July, is from an inch to an inch and a half in length, about three quarters of an inch in breadth, and hangs on a slender stem half an inch long and coated with long pale hairs; the involucres are furnished at the apex while young with conspicuous caducous tufts of pale tomentum, and are an inch long when fully grown, nearly glabrous at the apex, and sometimes slightly stained with red toward the base. The nut is about a quarter of an inch in length, and is gradually narrowed at the apex.

Ostrya Knowltoni, which is probably one of the rarest trees in the United States, has only been seen on the southern slope of the cañon of the Colorado River in Arizona at a point seventy miles north of Flagstaff, where the post-office and camp of Tolfree have been established, and where it grows by the trail leading to the bottom of the cañon at elevations between six and seven thousand feet above

the level of the sea. Here it is abundant, growing with *Pinus edulis*, *Pseudotsuga taxifolia*, *Abies concolor*, *Cercocarpus ledifolius*, *Quercus Gambelii*, *Cowania Mexicana*, *Fraxinus anomala*, *Fraxinus cuspidata*, and *Amelanchier alnifolia*, and here, remote from the other species of the genus, it was found by Mr. Frank H. Knowlton[1] on September 10, 1889.[2]

The wood of *Ostrya Knowltoni* is hard, close-grained, compact, and light reddish brown, with thin sapwood.[3]

[1] Frank Hall Knowlton was born in Brandon, Rutland County, Vermont, September 2, 1860. He was educated in the schools of his native place and at Middlebury College, Vermont, where he was graduated in 1884, and was then appointed an aid in the United States National Museum at Washington, a position in which he remained for three years. He was then made assistant curator of botany in the National Museum, and in 1889 he was appointed assistant palæontologist of the United States Geological Survey, a position which he still occupies, and passed several months in collecting in the southwest. Since 1887 Mr. Knowlton has filled the chair of Botany in the Columbian University in Washington. He is the author of many important papers on palæobotany published in the *Proceedings of the United States National Museum* and in the *Bulletins of the United States Geological Survey.*

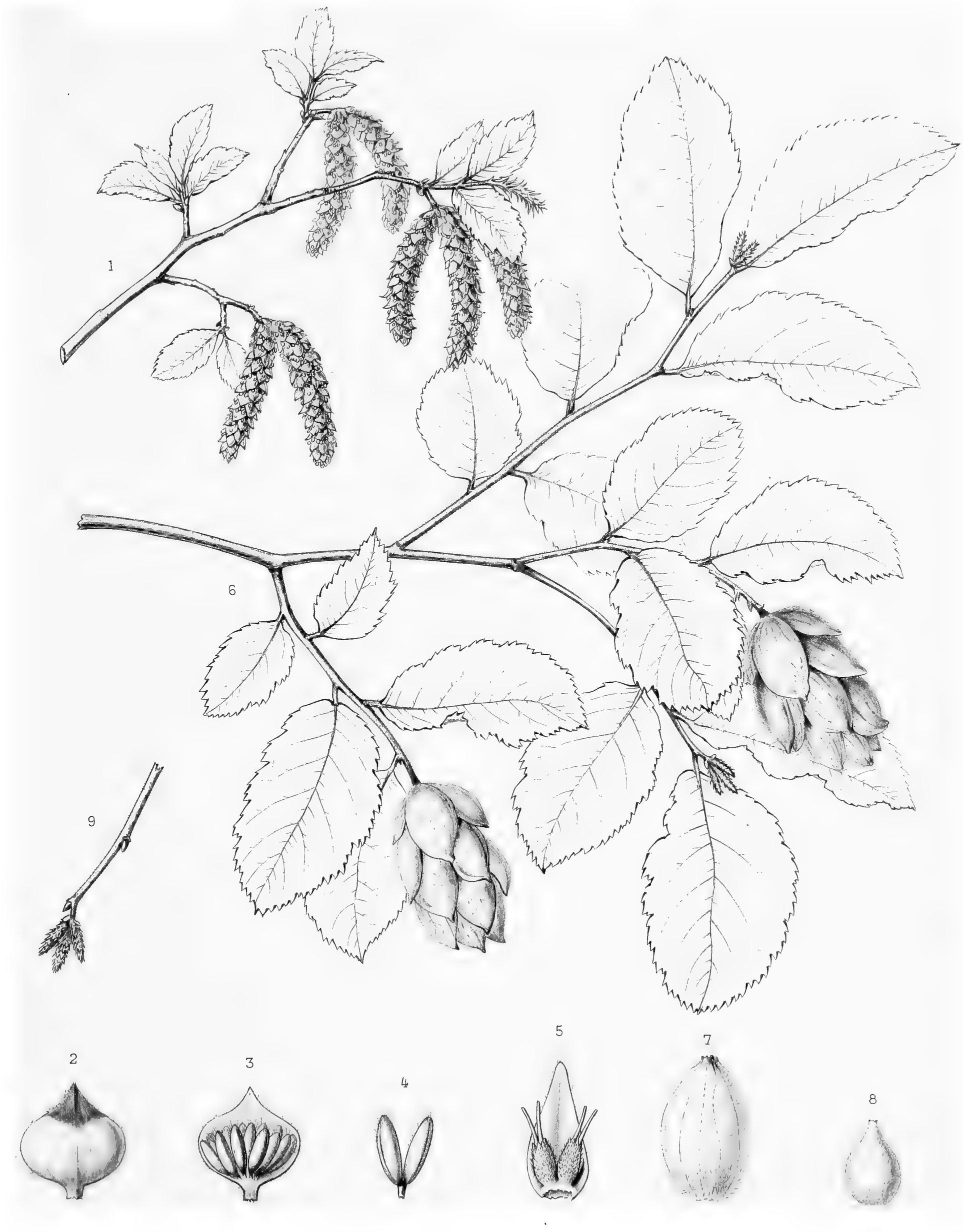
[2] *Ostrya Knowltoni* was subsequently collected in fruit by Professor J. W. Toumey in July, 1892. The trees were visited by Professor Toumey and myself in September, 1894, when no traces of fruit could be found upon them. For flowering specimens collected in May, 1895, I am indebted to Mr. L. H. Tolfree of Tolfree, Arizona.

[3] The trunk specimen of *Ostrya Knowltoni* in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is four inches in diameter inside the bark, and shows seventy-six layers of annual growth, six of which are of sapwood.

EXPLANATION OF THE PLATE.

PLATE CCCCXLVI. OSTRYA KNOWLTONI.

1. A flowering branch, natural size.
2. A scale of the staminate ament, rear view, enlarged.
3. A staminate flower with its scale, front view, enlarged.
4. A stamen, enlarged.
5. Pistillate flowers with their scale, front view, enlarged.
6. A fruiting branch, natural size.
7. A fruiting involucre, natural size.
8. A nut, enlarged.
9. End of a winter branch with staminate aments, natural size.



C.E.Faxon del.

Himely sc.

OSTRYA KNOWLTONI, Cov.

A.Riocreux direx.t

Imp.J.Taneur, Paris.

CARPINUS.

FLOWERS unisexual, monœcious, apetalous, the staminate naked in pendulous aments; stamens 3 to 20; the pistillate in lax semierect aments; calyx denticulate, adnate to the inferior two-celled ovary, subtended by a bract and two bractlets; ovule solitary in each cell, suspended. Fruit a nut at the base of a leafy open or more or less infolded involucre formed from the accrescent bract and bractlets of the flower.

Carpinus, Linnæus, *Gen.* 292 (excl. Ostrya) (1737). — Adanson, *Fam. Pl.* ii. 375 (excl. Ostrya). — A. L. de Jussieu, *Gen.* 409 (excl. Ostrya). — Endlicher, *Gen.* 274. — Meisner, *Gen.* 346. — Baillon, *Hist. Pl.* vi. 255 (excl. Ostrya). — Bentham & Hooker, *Gen.* iii. 405. — Engler, *Engler & Prantl Pflanzenfam.* iii. pt. i. 42.

Distegocarpus, Siebold & Zuccarini, *Abhand. Akad. Münch.* iv. pt. iii. 226 (1846).

Trees, with watery juice, smooth close or scaly bark, hard close-grained wood, slender terete branchlets, buds[1] covered with numerous imbricated accrescent scales marking in falling the base of the branch with narrow ring-like scars, the lower sterile, the upper the stipules of the first leaves, and fibrous roots. Leaves open and concave in the bud,[2] obliquely plicate along the primary veins, alternate, ovate, acute, often cordate at the base, doubly serrate, penniveined, the veins running obliquely to the points of the teeth, petiolate, deciduous, leaving in falling small semioval slightly oblique leaf-scars marked with the ends of three equidistant fibro-vascular bundles. Stipules strap-shaped or oblong-obovate, scarious, infolding the leaf in the bud, caducous. Flowers appearing in early spring with the unfolding of the leaves, the staminate in pendulous aments emerging in very early spring from axillary buds formed the previous season usually near the ends of short lateral branches of the year and closed during the winter, the pistillate in lax semierect aments terminal on leafy branches of the year. Staminate flower composed of from three to twenty stamens crowded on a pilose torus adnate to the base of a subsessile or stipitate broadly ovate and acute or lanceolate concave scale longer than the stamens; filaments filiform, abbreviated, two-branched near the apex, each branch bearing a one-celled erect oblong extrorse yellow half-anther tipped with a cluster of long hairs, the cell opening longitudinally. Pistillate flowers borne in pairs at the base of an ovate acute leafy deciduous scale, each flower subtended by a small acute lateral bract with two minute bractlets or appendages at its base. Calyx adnate to the ovary, dentate on the free narrow border. Ovary inferior, two-celled after fecundation, crowned with a short style divided into two elongated linear subulate spreading branches stigmatic on the inner face and exserted above the leafy scale; ovule solitary in each cell, suspended, anatropous, the micropyle superior. Fruiting involucres formed by the enlargement of the bract and bractlets of the flower, fully grown at midsummer, ovate, acute, conspicuously three-lobed or lobulate, thick and firm, green and foliaceous, coarsely serrate, sometimes only on one margin, penniveined, reticulate-venulose, embracing the base only of the nut, open and spreading, loosely imbricated into a long-stalked open cluster (Eucarpinus), or broadly ovate, acute, not at all or slightly lobed at the base or only on one side, membranaceous, nearly white, serrate toward the apex with prominent rigid teeth, longitudinally ribbed, reticulate-venulose, hairy at the base, more or less folded below over the nut and inclosing it, closely imbricated into a short or elongated strobile borne on a slender pendulous peduncle furnished

[1] Carpinus does not form a terminal bud, the end of the branch dying in summer and leaving during the following winter a small circular scar close to the upper axillary bud, which continues the branch the next season (Foerste, *Bull. Torrey Bot. Club*, xx. 164, t. 148, f. 17).

[2] Henry, *Nov. Act. Acad. Cæs. Leop.* xviii. 529, t. 39, xxii. 183, t. 29.

with two or three small linear acute deciduous bractlets (Distegocarpus). Nut ovate, acute, compressed, conspicuously longitudinally ribbed, crowned by the remnants of the calyx-lobes, and marked at the broad base with a large conspicuous pale oval umbilicus, deciduous from the involucre in the autumn at maturity; pericarp of two coats, the outer light brown, thin, and membranaceous, the inner thicker, hard, and bony. Seed solitary by abortion, filling the cavity of the nut, suspended, exalbuminous; testa membranaceous, light chestnut-brown; cotyledons thick and fleshy, plano-convex, epigæous in germination, much longer than the short superior radicle turned toward the conspicuous apical hilum.[1]

Ten or twelve species of Carpinus are now known. One is widely distributed through the temperate regions of eastern North America, ranging southward to the highlands of Central America. Two species inhabit Europe; of these, *Carpinus Betulus*[2] is widely and generally spread through the lowland forests of central and southern Europe, where it ranges from southern England and southern Scandinavia to northern Spain, France, Italy, the countries bordering the lower Danube, central Russia, the Caucasus, and northern Persia, and *Carpinus Duinensis*[3] is confined to the southern and south-eastern parts of the continent and to western Asia, where it is found in mountain forests from Sicily and central Italy to Hungary, Greece, Asia Minor, Transcaucasia, northern Persia, and Turkestan. Two species are found on the temperate Himalaya;[4] two or three are probably endemic in China;[5]

[1] The species of Carpinus may be grouped in the following sections: —

Eucarpinus. Scales of the staminate ament broadly ovate, subsessile. Fruiting involucres foliaceous, conspicuously or (*Carpinus Duinensis*) obscurely three-lobed, open or slightly infolded over the nut, loosely imbricated. Bark close and smooth. Inhabitants of eastern North America, Europe, western Asia, the Himalayas, China, and Japan.

Distegocarpus. Scales of the staminate ament lanceolate, stipitate. Fruiting involucres membranaceous, nearly white, longitudinally ribbed, coarsely dentate toward the apex, infolded below and covering the nuts, closely imbricated into a short or elongated strobile. Bark loose and scaly. Inhabitants of western Asia.

[2] Linnæus, *Spec.* 998 (excl. habitat Canada) (1753). — Scopoli, *Fl. Carn.* ed. 2, ii. 243. — Hornemann, *Fl. Dan.* viii. t. 1345. — *Nouveau Duhamel*, ii. 198, t. 58. — Smith & Sowerby, *English Bot.* xxix. t. 2032. — Reichenbach, *Icon. Fl. German.* xii. 4, t. 632. — Hartig, *Forst. Culturpfl. Deutschl.* 229, t. 21. — A. de Candolle, *Prodr.* xvi. pt. ii. 126. — Parlatore, *Fl. Ital.* iv. 145. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 237. — Boissier, *Fl. Orient.* iv. 1177. — Hempel & Wilhelm, *Bäume und Sträucher*, ii. 30, f. 137–139, t. 17.

Carpinus Carpinizza, Host, *Fl. Aust.* ii. 626 (1831).

Carpinus intermedia, Reichenbach, *l. c.* xii. 4, t. 633 (1850).

The European Hornbeam, which usually grows in cold heavy clay soil in low situations, often near streams, and rarely in mountain forests, sometimes attains the height of sixty or seventy feet, with a straight trunk and a dense symmetrical round-topped head. The wood is nearly white, strong, heavy, and coarse-grained, and is marked with numerous broad conspicuous medullary rays; igniting quickly and producing a bright clear flame, it is chiefly used as firewood; it also makes excellent charcoal, and is employed for the handles of tools, wooden screws, the teeth of cog-wheels, and other small articles.

Carpinus Betulus produces vigorous stump shoots in great profusion, and is often planted in coppice. The dried leaves are valued and largely consumed in central Europe as forage for domestic animals (Mathieu, *Fl. Forestière*, ed. 3, 341).

The ability of this tree to support frequent and severe pruning makes it a valuable hedge plant, and it was formerly largely employed for this purpose, and for the clipped borders of alleys and mazes in the formal seventeenth century gardens of France and Germany. (See London & Wise, *The Retired Gardener*, ii. 741. — Duhamel, *Traité des Arbres*, i. 128. — Evelyn, *Silva*, ed. Hunter, i. 141. — Marshall, *Planting and Rural Ornament*, ii. 52. — Loudon, *Arb. Brit.* iii. 2009.)

A number of abnormal forms of the European Hornbeam have appeared and are sometimes cultivated. The most distinct are those with pendulous branches, with upright growing branches forming a narrow pyramidal head, and those with incisely cut and with purple leaves (Dippel, *Handb. Laubholzk.* ii. 140).

Carpinus Betulus is occasionally planted in the parks and gardens of the eastern United States, and is hardy as far north at least as eastern Massachusetts, where it grows vigorously to a large size.

[3] Scopoli, *l. c.* t. 60 (1772). — A. de Candolle, *l. c.* 127. — Parlatore, *l. c.* 148. — Boissier, *l. c.* — Hempel & Wilhelm, *l. c.* 34, f. 140.

Carpinus orientalis, Lamarck, *Dict.* i. 707 (1783). — Watson, *Dendr. Brit.* ii. 98, t. 98. — Reichenbach, *l. c.* 5, t. 634.

This small bushy tree with rather closely imbricated fruiting involucres, entire or somewhat lobulate and slightly infolded at the base, is chiefly interesting as showing the close connection between the species of Eucarpinus and those of the Asiatic Distegocarpus group. It is occasionally planted in the gardens of eastern America, and is perfectly hardy as far north as eastern New England, an old specimen twelve or fifteen feet tall and broad which stands in the Botanic Garden of Harvard College, in Cambridge, Massachusetts, ripening its fruit in the greatest profusion.

[4] Brandis, *Forest Fl. Brit. Ind.* 492, t. 66. — Hooker f. *Fl. Brit. Ind.* v. 625.

[5] Of the nature and character of the Chinese species of Carpinus little is yet known. What appears to be the *Carpinus viminea*, Lindley (Wallich, *Pl. As. Rar.* ii. 4, t. 106 [1831]), of the Himalayas has been found by Dr. Augustine Henry in the Province of Szechuen; and on the mountains near Peking the Russian botanist Turczaninow found a small shrubby Carpinus resembling *Carpinus Duinensis* (*Carpinus Turczaninovii*, Hance, *Jour. Linn. Soc.* x. 203 (1869). — Maximowicz, *Bull. Acad. Sci. St. Pétersbourg*, xxvii. 535 [*Mél. Biol.* xi. 315]. — Franchet, *Nouv. Arch. Mus.* sér. 2, vii. 278 [*Pl. David.* i.]). The Japanese *Carpinus laxiflora* is said to grow in central China (Franchet, *l. c.* 279); and *Carpinus cordata* of Japan probably occurs in the northern part of the Chinese empire, as it is a common inhabitant of the Manchurian forests in the neigh-

and three are indigenous in Japan. Of these two species, *Carpinus Carpinus*[1] and *Carpinus cordata*,[2] constitute the section Distegocarpus, and the third, *Carpinus laxiflora*,[3] is a Eucarpinus. Traces of Carpinus have been found in the tertiary rocks of Alaska,[4] and in the upper miocene of the Colorado parks and of Nevada,[5] regions from which the genus has now entirely disappeared; and in those of the eocene and miocene of Europe palæontologists have discovered impressions of the leaves and fruits of several species.[6]

Carpinus produces hard close-grained wood and astringent bark sometimes used in Europe for tanning leather.

In America Carpinus is not seriously injured by insects[7] or subject to fungal diseases.[8]

Carpinus can be easily raised from seed, which usually does not germinate until the second year, and the varieties can be grafted.

Carpinus, the classical name of the Hornbeam, was adopted by Tournefort,[9] and afterward by Linnæus, who united with it the Ostrya of earlier botanists.

borhood of Vladivostock (Regel, *Mém. Acad. Sci. St. Pétersbourg*, sér. iv. 130 [*Tent. Fl. Ussur.*]. — Trautvetter, *Act. Hort. Petrop.* ix. 165 [*Incrementa Fl. Ross.*]).

[1] Sargent, *Garden and Forest*, vi. 364, f. 56 (1893); *Forest Fl. Japan*, 64, t. 21.

Distegocarpus Carpinus, Siebold & Zuccarini, *Abhand. Akad. Münch.* iv. pt. iii. 227, t. 3, C (1846). — A. de Candolle, *Prodr.* xvi. pt. iii. 128.

Carpinus Japonica, Blume, *Mus. Bot. Lugd. Bat.* i. 308 (1850). — Miquel, *Ann. Mus. Lugd. Bat.* i. 121. — Franchet & Savatier, *Enum. Pl. Jap.* i. 451. — Maximowicz, *Bull. Acad. Sci. St. Pétersbourg*, xxvii. 533 (*Mél. Biol.* xi. 311).

This is a tree forty or fifty feet in height, with a straight trunk from twelve to eighteen inches in diameter, and wide-spreading branches which form a beautiful round-topped symmetrical head. Very abundant at two thousand feet above the level of the sea in the deciduous-leaved forests of the Hakone and Nikko Mountains in central Hondo, it does not appear to range far northward in that island or to reach southern Yezo. Introduced about twenty years ago into the gardens of central and western Europe and into those of the United States, *Carpinus Carpinus* flourishes on the Atlantic seaboard as far north as eastern Massachusetts, and is conspicuous in American gardens from its compact pyramidal habit, its dark green leaves, and large hop-like strobiles of fruit.

[2] Blume, *l. c.* 309 (1850). — Miquel, *l. c.* — Franchet & Savatier, *l. c.* 452. — Maximowicz, *l. c.* (*l. c.* 312). — Sargent, *Garden and Forest*, viii. 294, f. 41; *Forest Fl. Japan*, *l. c.*

Distegocarpus ? cordata, A. de Candolle, *l. c.* (1864).

Carpinus cordata is one of the most distinct and beautiful of the Hornbeams. It is often forty feet in height, with a straight trunk eighteen inches in diameter covered with dark deeply furrowed scaly bark, a broad round-topped head of large thin deeply cordate leaves, winter-buds often an inch long, and fruit-clusters five or six inches in length. Comparatively rare at high elevations on the mountains of Hondo, *Carpinus cordata* is one of the commonest trees in the deciduous-leaved forests of central Yezo, and is there the only representative of the genus, as it probably is in Manchuria, where this species reaches a more northern station in Asia than is attained by any other Hornbeam.

[3] Blume, *l. c.* (1850). — Miquel, *l. c.* — Franchet & Savatier, *l. c.* 451. — Maximowicz, *l. c.* 536 (*l. c.*). — Sargent, *Garden and Forest*, vi. 364; *Forest Fl. Japan*, *l. c.*

Distegocarpus laxiflora, Siebold & Zuccarini, *l. c.* 228 (1846). — A. de Candolle, *l. c.*

Carpinus laxiflora is a slender graceful tree occasionally fifty feet in height, with a trunk eighteen or twenty inches in diameter covered with smooth pale sometimes nearly white bark, and slender open clusters of fruit. It is the Japanese representative of Eucarpinus, and a common inhabitant of all mountain forests in the southern islands; it is usually found at elevations of from two to three thousand feet above the ocean, but on the southern shores of Volcano Bay in southern Yezo, where it finds its northern home, it grows at the sea-level to its largest size in forests of White Oaks.

Of the other Hornbeams described in books on the flora of Japan, *Carpinus erosa* (Blume, *l. c.* 308) and *Carpinus Tschonoskii* (Maximowicz, *l. c.* 534 [*l. c.* 313]) are doubtful species unknown to Japanese botanists; and *Carpinus Yedoensis* (Maximowicz, *l. c.* [*l. c.* 314]), a small Eucarpinus not unlike the Himalayan *Carpinus viminea*, Lindley, is only known in the empire as a cultivated plant by the borders of rice-fields in the neighborhood of Tōkyō, and is perhaps, like many other plants cultivated by the Japanese, of Chinese origin (Sargent, *Forest Fl. Japan*, *l. c.*).

[4] Heer, *Svensk. Vetensk. Akad. Handl.* t. 11, f. 12 (*Fl. Foss. Alask.*).

[5] Lesquereux, *Rep. U. S. Geolog. Surv.* vii. 142, t. 19, f. 9, t. 64, f. 8–10; viii. 152, t. 27, f. 10, 12–14 (*Contrib. Fossil Fl. W. Territories*, ii., iii.).

[6] Saporta, *Origine Paléontologique des Arbres*, 148. — Zittel, *Handb. Palæontolog.* ii. 420.

[7] The few species of insects that are recorded as living on Carpinus in North America are usually more common on other trees. The Fall Web-worms and one or two species of the large American Silk-worms and other Bombycidæ find the leaves of the Hornbeam palatable food, and other leaf-eating insects live on the foliage, but have never been reported as occurring in large numbers. No borers are especially destructive to the stems, although *Acoptus suturalis*, Leconte, has been found boring into the branches (*Proc. Entomolog. Soc. Washington*, ii. 70).

[8] The most conspicuous and abundant fungus on Carpinus in the United States is *Pezicula carpinea*, Tulasne, which sometimes covers the branches for distances of several feet. It appears in the form of clusters of small flat cups or knobs, which rupture the outer bark and probably cause the death of the branch. *Nœmospora aurea*, Fries, an imperfect fungus, is often seen on the branches of Carpinus, upon which, in moist weather, it produces small yellow exudations, at first tendril-like in shape. Several fungi of the order Pyrenomycetes, like *Diaporthe Carpini*, Fackel, and *Fracchiœa callista*, Saccardo, also live on Carpinus without seriously injuring it.

[9] *Inst.* 582, t. 382.

CARPINUS CAROLINIANA.

Hornbeam. Blue Beech.

INVOLUCRES of fruit usually 3-lobed, and coarsely toothed on one margin. Leaves ovate-oblong, sharply serrate.

Carpinus Caroliniana, Walter, *Fl. Car.* 236 (1788). — A. de Candolle, *Prodr.* xvi. pt. ii. 126. — K. Koch, *Dendr.* ii. pt. ii. 4. — Ridgway, *Proc. U. S. Nat. Mus.* v. 85. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 158. — Lauche, *Deutsche Dendr.* ed. 2, 283. — Watson & Coulter, *Gray's Man.* ed. 6, 474. — Dippel, *Handb. Laubholzk.* ii. 141, f. 66.

Carpinus Betulus, Linnæus, *Spec.* 998 (in part) (1753). — Koehne, *Deutsche Dendr.* 116 (in part).

Carpinus Betulus Virginiana, Marshall, *Arbust. Am.* 25 (not *Carpinus Virginiana*, Miller) (1785).

Carpinus Americana, Michaux, *Fl. Bor.-Am.* ii. 201 (1803). — Willdenow, *Spec.* iv. pt. i. 468; *Berl. Baumz.* ed. 2, 75; *Enum.* Suppl. 64. — Persoon, *Syn.* ii. 573. — Poiret, *Lam. Dict.* Suppl. ii. 202. — Michaux f. *Hist. Arb. Am.* iii. 57, t. 8. — Aiton, *Hort. Kew.* ed. 2, v. 301. — Pursh, *Fl. Am. Sept.* ii. 623. — Nuttall, *Gen.* ii. 218. — Hayne, *Dendr. Fl.* 168. — Elliott, *Sk.* ii. 618. — Bigelow, *Fl. Boston.* ed. 2, 357. — Watson, *Dendr. Brit.* ii. 157, t. 157. — Sprengel, *Syst.* iii. 855. — Guimpel, Otto & Hayne, *Abbild. Holz.* 107, t. 84. — Loudon, *Arb. Brit.* iii. 2013, f. 1936. — Hooker, *Fl. Bor.-Am.* ii. 160. — Spach, *Ann. Sci. Nat.* sér. 2, xvi. 252; *Hist. Vég.* xi. 224. — Torrey, *Fl. N. Y.* ii. 185, t. 103. — Emerson, *Trees Mass.* 174; ed. 2, i. 198, t. — Dietrich, *Syn.* v. 304. — Darlington, *Fl. Cestr.* ed. 3, 273. — Chapman, *Fl.* 425. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 75. — Mayr, *Wald. Nordam.* 177.

A bushy tree, rarely forty feet in height, with a short fluted trunk occasionally two feet in diameter, and a wide graceful airy head; usually much smaller, and at the north generally shrubby with numerous slender spreading stems. The bark of the trunk is light gray-brown, sometimes marked with broad dark brown horizontal bands, smooth, close, and compact, and from a sixteenth to an eighth of an inch in thickness. The branches, which are long, slightly zigzag, slender, and very tough, spreading gradually from the stem at first, are pendulous toward the extremities, and furnished with numerous short thin lateral branchlets growing at acute angles, the whole forming in summer broad flat-topped masses of foliage; when they first appear the branchlets are pale green and coated with long white silky hairs, soon becoming bright red on the side exposed to the sun; during the summer they are orange-brown, conspicuously marked with small white lenticels which do not disappear for two or three years, and sometimes slightly pilose; they become dark red and lustrous during the first winter, then gradually lighter, and ultimately a dull gray tinged with red. The winter-buds are ovate, acute, about an eighth of an inch long, and covered with ovate acute puberulous light chestnut-brown scales white and scarious on the margins; those of the inner ranks lengthen slightly with the branch, and when fully grown are light red above the middle and green below, and sometimes nearly half an inch long. The leaves are ovate-oblong, often somewhat falcate, long-pointed, sharply and doubly serrate with stout spreading glandular teeth except at the base, which is rounded, wedge-shaped, or rarely subcordate, and often unequal by the greater development of one side; when they unfold they are pale bronze-green and covered with long white hairs, which are more crowded on the lower side, and when fully grown they are thin and firm in texture, pale dull blue-green on the upper surface, light yellow-green, glabrous or puberulous, and marked with small tufts of white hairs in the axils of the veins on the lower surface, from two to four inches long, and from an inch to an inch and three quarters wide, with slender yellow midribs rounded and slightly raised on the upper side, and numerous slender veins running obliquely to the points of the teeth, deeply impressed and conspicuous above, and connected by prominent cross veinlets; they are borne on slender terete hairy petioles about a third of an inch in length and bright red at first, and turn to deep scarlet and orange-color late in the autumn before

falling. The stipules are ovate-lanceolate, acute, pubescent, hairy on the margins, bright red below, and light yellow-green at the apex, a third of an inch long, and caducous. The staminate ament-buds are formed in the autumn, and, during the winter, although nearly twice as large, otherwise resemble the leaf-buds; the aments begin to lengthen very early in the spring, and when fully grown are about an inch and a half long, with broadly ovate acute boat-shaped scales green below the middle and bright red at the apex. The pistillate aments are from one half to three quarters of an inch long, with ovate acute hairy green scales and bright scarlet styles. The fruit hangs from the ends of leafy branches in open clusters on slender terete pubescent red-brown stems five or six inches long; the involucres are short-stalked, usually three-lobed, although one of the lateral lobes is often wanting, halberd-shaped, coarsely serrate, usually on one margin of the middle lobe, or entire, from one to one and a half inches long, and nearly an inch wide across the lateral lobes. The nut, which is only slightly inclosed at the base by the involucre, is a third of an inch in length.

Carpinus Caroliniana, which inhabits the borders of streams and swamps, growing usually in deep moist rich soil, is distributed from southern and western Quebec up the valley of the Ottawa River to that of the Mattawa, and westward to the northern shores of Georgian Bay,[1] southward to Cape Malabar and the shores of Tampa Bay in Florida, and westward in the United States to northern Minnesota,[2] eastern Nebraska[3] and Kansas, the Indian Territory, and the valley of the Trinity River in Texas, reappearing on the mountains of southern Mexico and Central America.[4] A common inhabitant of the eastern and central states, except the elevated parts of northern New England and New York, the Hornbeam is most abundant and grows to its largest size on the western slopes of the southern Alleghany Mountains and in southern Arkansas and eastern Texas.

The wood of *Carpinus Caroliniana* is heavy, very strong, hard, and close-grained; it is light brown, with thick nearly white sapwood, and contains numerous broad medullary rays. The specific gravity of the absolutely dry wood is 0.7286, a cubic foot weighing 45.41 pounds. It is sometimes used for levers, the handles of tools, and other small articles.[5]

The graceful habit of the American Hornbeam, its smooth and beautifully fluted stem, its dark blue-green foliage, and the splendor of its autumnal tints, make it a desirable ornament for the parks and gardens of eastern North America.

[1] Brunet, *Cat. Vég. Lig. Can.* 51. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 52°. — Macoun, *Cat. Can. Pl.* 439.

[2] Macmillan, *Metaspermæ of the Minnesota Valley*, 186.

[3] Bessey, *Rep. Nebraska State Board Agric.* 1894, 110.

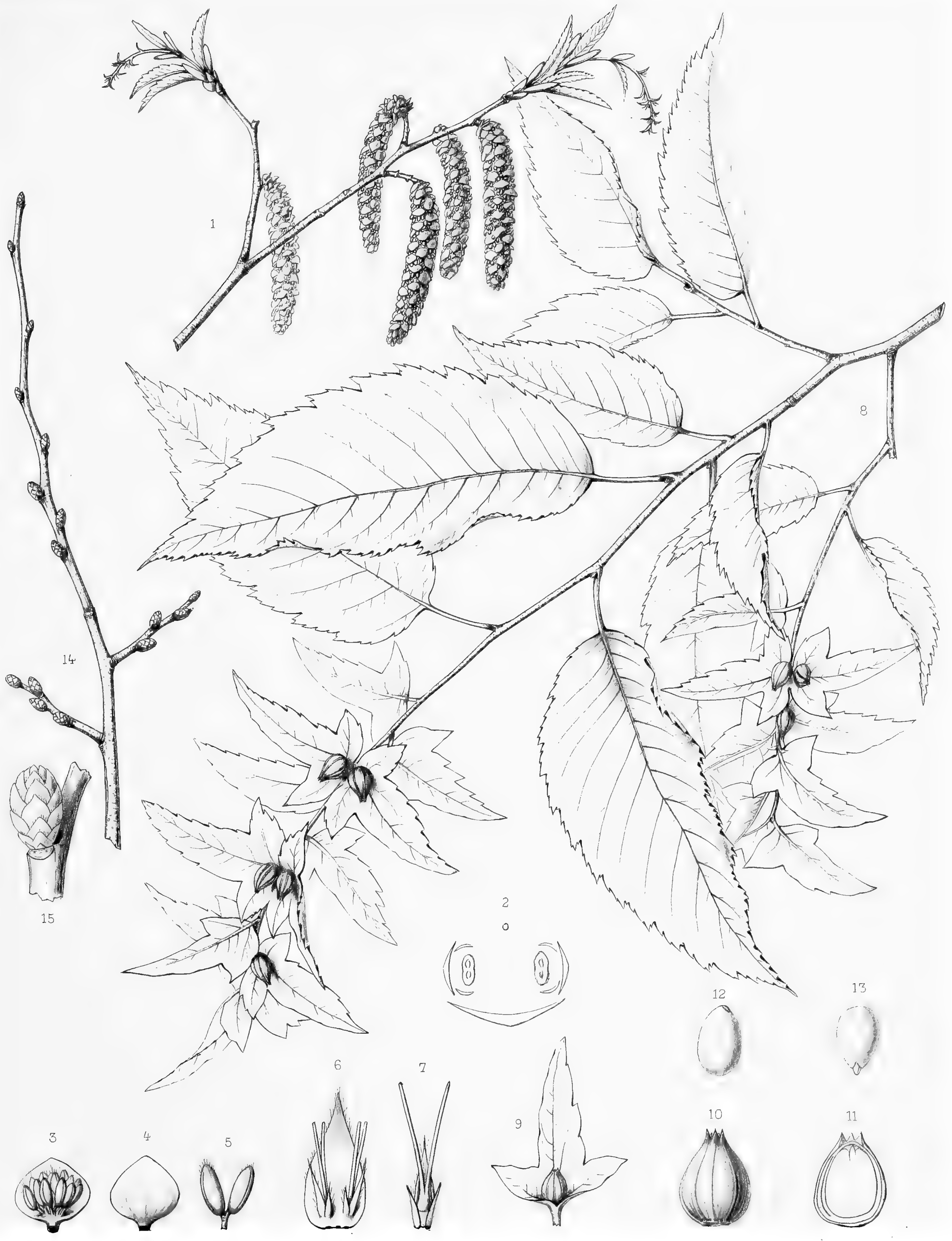
[4] Hemsley, *Bot. Biol. Am. Cent.* iv. 87. — Donnell-Smith, *Bot. Gazette*, xv. 28 (*Carpinus Americana*, var. *tropicalis*).

[5] "The Horne bound tree is a tough kind of Wood, that requires so much paines in riving as is almost incredible, being the best for to make bolles and dishes, not being subject to cracke or leake." (Wood, *New England's Prospect*, pt. i. chap. 5, 15.)

EXPLANATION OF THE PLATE.

PLATE CCCCXLVII. CARPINUS CAROLINIANA.

1. A flowering branch, natural size.
2. Diagram of a pistillate flower-cluster.
3. A staminate flower with its scale, front view, enlarged.
4. Scale of a staminate ament, rear view, enlarged.
5. A stamen, enlarged.
6. Pistillate flowers with their scale, front view, enlarged.
7. A pistillate flower with bract and bractlets, enlarged.
8. A fruiting branch, natural size.
9. A nut with its involucre, natural size.
10. A nut, enlarged.
11. Vertical section of a nut, enlarged.
12. A seed, enlarged.
13. An embryo, enlarged.
14. A winter branch, natural size.
15. A staminate ament in winter, enlarged.



C.E.Faxon. del.

Himely sc.

CARPINUS CAROLINIANA, Walt.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

BETULA.

Flowers unisexual, monœcious, apetalous, the staminate in long pendulous aments; calyx membranaceous, 4-lobed; stamens 2; the pistillate in erect cylindrical aments; ovary naked, 2-celled; ovule solitary in each cell, suspended. Fruit a winged nut covered by the enlarged scale of the ament. Leaves alternate, dentate or serrate, stipulate, deciduous.

Betula, Linnæus, *Gen.* 285 (1737). — Adanson, *Fam. Pl.* ii. 375 (in part). — A. L. de Jussieu, *Gen.* 409 (in part). — Endlicher, *Gen.* 272; Suppl. iv. pt. ii. 19. — Meisner, *Gen.* 351. — Baillon, *Hist. Pl.* vi. 254. — Bentham & Hooker, *Gen.* iii. 404. — Prantl, *Engler & Prantl Pflanzenfam.* iii. pt. i. 43.

Betulaster, Spach, *Ann. Sci. Nat.* sér. 2, xv. 198 (*Revisio Betulacearum*) (1841).

Trees or shrubs, with watery juice, furrowed scaly resinous bark smooth on young stems, marked with long horizontal lenticels and often separating into thin papery plates, hard close-grained wood, slender tough terete branches marked with pale lenticels persistent for many years, and furnished with short stout spur-like two-leaved lateral branchlets conspicuously roughened by the crowded leaf-scars of many previous years, elongated buds full grown at midsummer and in winter covered by ovate acute scales, those of the inner ranks accrescent and marking in falling the base of the branch with persistent ring-like scars,[1] and fibrous roots. Leaves open and convex in the bud, becoming conduplicate or even revolute as it expands, obliquely plicately folded along the primary veins,[2] alternate, dentate, usually doubly, often incisely lobed, penniveined, the veins running obliquely to the points of the teeth, petiolate, persistent, deciduous, leaving when they fall small semioval leaf-scars displaying the ends of three equidistant fibro-vascular bundles. Stipules ovate, acute, or oblong-obovate, scarious, inclosing the leaf in the bud, caducous. Flowers opening in early spring, with or before the unfolding of the leaves, monœcious, sessile, in three-flowered cymes in the axils of the scales of pendulous or erect aments, the lateral flowers of the cyme subtended by bractlets adnate to the base of the scale. Staminate aments pendulous, elongated, solitary or clustered, sessile or short-pedunculate, appearing in the summer or autumn in the axils of the last leaves of the branch of the year, or near the ends of the short lateral branchlets of the year, or rarely from the axils of all but the upper leaves of the year,[3] erect and naked during the winter; scales broadly ovate, rounded, short-stalked, yellow or orange-color below the middle and dark chestnut-brown at the apex. Calyx sessile, membranaceous, irregularly four-lobed or usually two-lobed by suppression, the anterior lobe obovate, rounded at the apex, concave, as long as

[1] Betula does not form a terminal bud, the end of the branch dying and falling during the summer, leaving a minute circular scar close to the upper axillary bud, which prolongs the branch the following season.

[2] Henry, *Nov. Act. Acad. Cæs. Leop.* xviii. 527, t. 39.

The sterile leaf-buds, which are usually confined, except on young plants, to the terminal branches, are covered with two opposite pairs of scales, and the buds on the short lateral branchlets, which contain two leaves and the pistillate inflorescence, are inclosed by several loosely imbricated scales, the lowest being sterile. The short lateral branchlets continue to produce pistillate aments and pairs of leaves for many years, and finally grow into branches which may also develop flowering branchlets from the axils of their primary leaves.

[3] In *Betula pumila* and *Betula nana* the staminate aments are usually produced singly from leafless or rarely leafy buds in the axils of all but the three or four upper leaves of the shoot, and are therefore below the pistillate catkins, which are terminal on the leafy shoots of the year from buds in the axils of the last leaves of the previous year. In the other species of Betula which I have been able to examine, the staminate aments are higher on the branch than those containing the pistillate flowers.

the stamens, much longer than the minute posterior lobe. Stamens two, anterior and posterior, inserted on the base of the calyx; filaments abbreviated, divided near the apex into two branches, each division bearing an erect subsessile half-anther, its cell opening longitudinally. Pistillate aments oblong or cylindrical, pedunculate or subsessile, solitary, terminal on the short two-leaved lateral spur-like branchlets of the year, or rarely racemose, their peduncles bibracteolate; scales closely imbricated, oblong-ovate, three-lobed, rounded or acute at the apex, light yellow-green often tinged with red above the middle, accrescent, becoming brown and woody at maturity and forming a sessile or pedunculate, erect or pendulous, short or elongated, ovoid or cylindrical strobile, usually deciduous with the nuts from the slender rachis. Ovary sessile, naked, compressed, two-celled, crowned with two slender spreading filiform anterior and posterior styles stigmatic at the apex; ovule solitary, suspended from the interior angle of the cell, anatropous, the micropyle superior. Nut minute, light chestnut-brown, compressed, oval or obovate, crowned by the persistent stigmas, marked at the base with a small pale umbilicus; pericarp of two coats, the outer thin and membranaceous, produced into a narrow or broad marginal wing interrupted at the apex, the inner crustaceous or slightly indurate. Seed solitary by abortion, filling the cavity of the nut, exalbuminous; testa membranaceous, light brown; cotyledons fleshy, flat, much longer than the short superior radicle turned toward the minute apical hilum.[1]

Betula is widely distributed through North America, Europe, and central and northern Asia, its species sometimes forming vast boreal forests or in stunted forms covering high mountain slopes and inhabiting polar regions to the limits of perpetual snow. About twenty-four species may be distinguished.[2] Nine occur in North America; of these six are trees, and three, *Betula pumila*,[3] *Betula*

[1] By Regel (*De Candolle Prodr.* xvi. pt. ii. 162) the species of Betula are grouped in the following sections: —

EUBETULA. Strobiles solitary, their bracts longer than the fruit.

BETULASTER. Strobiles racemose, their bracts shorter than the fruit.

To the second section belong only the type of Spach's genus Betulaster, the Himalayan *Betula alnoides*, D. Don (*Prodr. Fl. Nepal.* 58 [1825]. — Hooker f. *Fl. Brit. Ind.* v. 599. *Betula acuminata*, Wallich, *Pl. As. Rar.* ii. 7, t. 109 [1831]. — Brandis, *Forest Fl. Brit. Ind.* 458, t. 56. *Betula cylindrostachys*, Wallich [*l. c.*]), and the Japanese *Betula Maximowicziana*, Regel.

[2] Spach, *Ann. Sci. Nat.* sér. 2, xv. 184 (*Revisio Betulacearum*). — Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 67 (*Monographia Betulacearum*); *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 395 (*Gattungen Betula und Alnus*); *De Candolle Prodr. l. c.* 161.

It is probable that the species of Betula intercross, like those of Quercus and Salix, and that natural hybrids between them are common, although comparatively few have yet been described. The best known is believed by European botanists to be a hybrid between *Betula alba* and *Betula nana*. This is —

Betula intermedia, Koch, *Syn. Fl. Germ. et Helv.* ed. 2, ii. 761 (1844). — Reichenbach, *Icon. Fl. German.* xii. 2, t. 624. — Regel, *Bull. Soc. Nat. Mosc. l. c.* 406; *De Candolle Prodr. l. c.* 170. — K. Koch, *Dendr.* ii. pt. i. 657. — Dippel, *Handb. Laubholzk.* ii. 170, f. 82.

Betula hybrida, Regel, *Nouv. Mém. Soc. Nat. Mosc. l. c.* 94, t. 8, f. 1–12 (1860).

Betula nana × *pubescens*, Koehne, *Deutsche Dendr.* 112 (1893).

Betula intermedia is an erect much-branched shrub with rhombic-ovate or ovate-subrotund acute glabrous leaves and cylindrical strobiles. It has been found on the Swiss Jura, in Sweden, in the neighborhood of St. Petersburg, and on the Altai Mountains in Siberia. It often seems intermediate between the two supposed parents, some individuals most strongly resembling the one and some the other, but their hybrid character usually disappears in succeeding generations.

In the Arnold Arboretum several plants appeared in 1888 among seedlings of *Betula pumila* which are supposed to be hybrids between that species and *Betula lenta* (*Betula pumila* × *lenta*, J. G. Jack, *Garden and Forest*, viii. 243, f. 36 [1895]), as they are intermediate between these species in the size and color of the leaves, in the position and size of the staminate aments, and in the size and shape of the strobiles of fruit and their bracts. Some of these hybrid plants possess the aromatic flavor and perfume of *Betula lenta*, while others have no trace of it. Some produce terminal staminate aments like *Betula lenta*, and on others the staminate aments are axillary and lower than the fertile aments, as upon *Betula pumila*. In their small size and shrubby habit, in the color of their branches, and in their usually obovate bluntly toothed leaves pale on the lower surface, the hybrids approach *Betula pumila*, while they differ from it in their greater vigor and larger size and in their larger fruit and leaves. In different places in northern and eastern New England individual trees which are almost exactly intermediate between *Betula papyrifera* and *Betula populifolia* are known and are perhaps natural hybrids between these species (Sargent, *Garden and Forest*, viii. 355, f. 50).

[3] Linnæus, *Mant.* 124 (1767). — Du Roi, *Harbk. Baumz.* i. 95, t. 3. — Jacquin, *Hort. Vind.* ii. 56, t. 122. — Wangenheim, *Nordam. Holz.* 86, t. 29, f. 61. — Willdenow, *Spec.* iv. pt. i. 467. — Tuckerman, *Am. Jour. Sci.* xlv. 29. — Macoun, *Cat. Can. Pl.* 437. — Watson & Coulter, *Gray's Man.* ed. 6, 472.

Betula Grayi, Regel, *Bull. Soc. Nat. Mosc. l. c.* 406, t. 6, f. 9–13 (1865); *De Candolle Prodr. l. c.* 171.

Betula pumila is a glandless shrub with slender erect stems from two to eight feet tall, small coriaceous obovate or orbicular leaves pale and coated below, like the young branchlets, with soft pubescence, staminate aments in the axils of lower leaves and below the pistillate aments, and oblong glabrous erect strobiles. An inhabitant of bogs, it is distributed from western Connecticut, New Jersey,

glandulosa,[1] and *Betula nana*,[2] are low shrubs. Six or seven species inhabit Europe, the most important, *Betula alba*,[3] also ranging in several forms through Siberia to Japan. Two species are

and eastern Massachusetts to Indiana and Minnesota, northward to Newfoundland, Labrador, Quebec, and Ontario, and westward in British America to the eastern foothills of the Rocky Mountains.

[1] Michaux, *Fl. Bor.-Am.* ii. 180 (1803). — Hooker, *Fl. Bor.-Am.* ii. 156. — Brewer & Watson, *Bot. Cal.* ii. 80. — Macoun, *Cat. Can. Pl.* 437. — Watson & Coulter, *Gray's Man.* ed. 6, 472.

Betula nana, Bigelow, *Fl. Boston.* ed. 2, 356 (not Linnæus) (1824). — Tuckerman, *Am. Jour. Sci.* xlv. 31. — Torrey, *Fl. N. Y.* ii. 101, t. 114. — Gray, *Man.* 423.

Betula pumila, Hooker, *l. c.* (not Linnæus) (1839).

Betula Littelliana, Tuckerman, *l. c.* 30 (1843).

Betula glandulosa is a shrub with glabrous erect or prostrate stems from one to four feet long, glabrous obovate or orbicular leaves green on both surfaces, and short oblong or oval strobiles. It is distributed from Newfoundland and Labrador westward by the shores of Hudson Bay to the valley of the Yukon River in Alaska, ranging southward to the alpine summits of the high mountains of New England and New York, to the northern shores of Lake Superior, the Rocky Mountains of Colorado, and the high Sierras of northern California.

[2] Linnæus, *Spec.* 983 (1753). — Michaux, *l. c.* — Guimpel, Willdenow & Hayne, *Abbild. Deutsch. Holz.* ii. 200, t. 148. — Hooker, *l. c.* — Smith & Sowerby, *English Bot.* xxxiii. t. 2326. — Hartig, *Forst. Culturpfl. Deutschl.* 333, t. 31. — Macoun, *l. c.*

Betula nana is a semiprostrate shrub with slender eglandular pubescent or tomentose branchlets and glabrous minute subrotund or flabellate leaves (var. *flabellifolia*, Hooker [*l. c.*]), and glabrous oval strobiles half an inch in length; it is an inhabitant of all arctic and subarctic regions and of the alpine summits of the high mountains of central Europe. In America, where it grows in cold sphagnous swamps, it ranges from Newfoundland to Alaska.

[3] Linnæus, *l. c.* 982 (1753).

Of this widely distributed species, which is spread all over northern Europe and Asia, growing nearer to the Pole than any other tree of the Old World, and inhabiting swamps and gravelly plains at the north, and the mountain ranges of southern Europe and Asia Minor, two subspecies are now generally recognized. The Fragrant Birch, —

Betula alba odorata, Dippel, *Handb. Laubholzk.* ii. 172 (1892).

Betula odorata, Bechstein, *Diana*, i. 74 (1815). — Reichenbach, *Icon. Fl. German.* xii. 2, t. 626.

Betula glutinosa, Wallroth, *Sched. Crit. Pl. Fl. Hal.* 496 (1822).

Betula torfacea, Custor, *Flora*, xx. pt. i. Beibl. 41 (1837).

Betula alba, Hornemann, *Fl. Dan.* ix. t. 1467 (1823). — Smith & Sowerby, *l. c.* xxxi. t. 2198. — Reichenbach, *l. c.* t. 623. — K. Koch, *Dendr.* ii. pt. i. 649.

Betula alba, *a vulgaris*, Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 75, t. 4, f. 1–18 (*Monographia Betulacearum*) (1860).

Betula alba, subspec. *verrucosa*, *a vulgaris*, Regel, *De Candolle Prodr.* xvi. pt. ii. 163 (1868).

and the Moor Birch,

Betula alba, subspec. *pubescens*, Dippel, *l. c.* 174 (1892).

Betula pubescens, Ehrhart, *Beitr.* vi. 98 (1791). — K. Koch, *l. c.*

The White Birch and some closely related species which are not distinguished commercially are the most useful inhabitants of the forests of the extreme northern parts of Europe and Asia. The wood of *Betula alba* is white slightly tinged with red, straight-grained, and moderately hard, although it soon decays when placed in the ground or exposed to the action of the weather. It makes excellent fuel, and for this purpose is used in great quantities in northern Europe in smelting furnaces; it is also largely employed in making charcoal, in turnery, and in cabinet-making; and in Russia the manufacture of wooden spoons from the wood of the Birch is a considerable industry in the Nizhni-Novgorod district (*Industries of Russia*, iii. 338).

The bark, especially the corky outer layer found on the lower portion of the trunk, is rich in tannin and is employed in tanning leather; a resinous balsamic essential oil distilled from it communicates the peculiar color and the characteristic odor of Russia leather (Pallas, *Reise*, French ed. ii. 264).

The production of Birch-bark oil is an important industry in some parts of northern Europe and in Siberia. It is obtained by a simple process of distillation, and the yield of the pure oil by weight is about one third of that of the bark used, about one hundred and fifty pounds of oil being obtained from twelve trees from thirty to fifty years old and of average size. Formerly the trees were cut down before the removal of the bark, but their increased value has caused the adoption of a system of cropping, the outer layers of bark being now stripped from the standing tree which survives the operation and yields successive crops of bark (Mathieu, *Fl. Forestière*, ed. 3, 359. — Spons, *Encyclopædia of the Industries, Arts, Manufactures, and Raw Commercial Products*, ii. 1417).

The peculiar resin, betulin, which is found in the white bark of the upper part of this tree and can be extracted by alcohol and crystallized, renders it impervious to water and preserves it uncorrupted for ages against the action of alternating heat and cold, moisture and dryness. This quality makes the bark of the White Birch valuable for many purposes: it is used to envelop and protect posts sunk in the ground and the sills of buildings, to cover the roofs of houses, the tops of walls, and the masonry of underground vaults, and in the manufacture of durable boxes, baskets, shoe-soles, and cords. It supplies the Laplander with a cloak which protects him from rain and snow, and the Russian peasant with boots and shoes (Loudon, *Arb. Brit.* iii. 1695). The starch contained in the cellular portion of the bark gives it alimentary importance in the extreme north, and mixed with the fat of the sea-wolf it is the principal food of the inhabitants of the coast of Kamtschatka during periods of famine (Lesseps, *Travels in Kamtschatka*, English ed. ii. 89).

From the sweet sap obtained in early spring from holes bored into the trunk of the tree vinegar is made, and a pleasant and wholesome effervescent wine is distilled. From the young branches, once the terror of youth, are made hoops, brooms, hurdles, baskets, and the ties for fagots. The leaves, which are bitter to the taste, afford a yellow dye and have been used in medicine; they are sometimes dried while young and fed to cattle and sheep, although few animals browse upon them after they have attained their full size.

The pure white bark of *Betula alba*, its graceful habit, its long slender pendulous branches, and its cheerful foliage, make it a popular inhabitant of parks and gardens of all cold countries, where, with its numerous varieties, it is very generally planted. *Betula alba* and some allied Old World species have been introduced into the northern United States, and here, although it is not long-lived, it is very hardy and grows rapidly, and is more often planted than any American species, especially in forms with pendulous branches or with laciniately cut leaves.

found in the forests of northern India,[1] and four or five others are endemic in northern China[2] and Japan.[3] The type is an ancient one; its traces appear in the cretaceous rocks of the Dakota group formation, and later, during the tertiary period, it spread over the central plateau and the northwest coast of North America,[4] and abounded in Europe, where palæontologists have recognized in the eocene, paleocene, and especially in the miocene, the remains of numerous species, the direct ancestors of those now living.[5]

The compact straight-grained wood of several species of Betula is valued by the cabinet-maker or is employed in the manufacture of spools, shoe-lasts, and other small articles; it burns with a bright clear flame and is largely used for fuel and in the making of charcoal. From the bark, which separates from the young stems and from the branches of several species in thin layers and is impervious to water, light canoes, shoes, boxes, cords, and a covering for buildings are made. The bark contains an astringent principle and a resinous balsamic oil sometimes used in tanning leather.[6] In North America the bark and leaves of the different species of Betula are esteemed as domestic remedies for chronic diseases of the skin and for rheumatism and gout, and the empyreumatic oil obtained from the inner bark by distillation is used externally and internally for the same purpose.[7] The sweet sap of many of the species is used as a beverage, and is sometimes made into wine.

Betula is not much injured in America by insects,[8] although many species are found on it, nor

[1] Brandis, *Forest Fl. Brit. Ind.* 457. — Kurz, *Forest Fl. Brit. Burm.* ii. 476. — Hooker f. *Fl. Brit. Ind.* v. 599.

[2] The Birch is a common tree on the high mountains of northern China, three or four species having been recognized which resemble those of Manchuria, where several Birch-trees, principally varieties of European and Siberian species, form a considerable portion of vast forests (Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 249, 391 [*Prim. Fl. Amur.*]).

[3] In Japan Betula does not form great forests, but several species are abundant at high elevations in Hondo and among the deciduous-leaved trees of Yezo. The common species of central Japan is *Betula Ermani*, Chamisso (*Linnæa*, vi. 537, t. 6, f. D. [1831]), an inhabitant also of Saghalin and Manchuria, and, as it stands among the dark Hemlocks in the great coniferous forests covering the high mountain slopes of central Japan, is one of the most beautiful of Birch-trees, with its silvery stem and wide-spreading bright orange-colored branches from which the bark separates in great plates.

Still more beautiful, however, is *Betula Maximowicziana*, Regel (*De Candolle Prodr.* xvi. pt. ii. 180 [1868], *Betula Maximowiczii*, Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 418, t. 6, f. 1–8 [*Gattungen Betula und Alnus*] [not Ruprecht] [1865]), which finds its home on the hills of central Yezo, and is a noble tree eighty or ninety feet in height, with a trunk often three feet in diameter, covered, except at the very base, with smooth orange-colored bark, dark red-brown branches, thin lustrous cordate leaves from four to six inches long and often more than four inches wide, and racemose strobiles. The bark, which separates in large plates from the trunk, is very durable and is used by the Ainos in the manufacture of numerous articles of domestic use.

Betula alba in at least three forms is common in northern and central Japan, where four other species are believed to occur, although none of them are common or well known in any part of the empire. (See Sargent, *Forest Fl. Japan*, 61.)

[4] Lesquereux, *Rep. U. S. Geolog. Surv.* vii. 137, t. 17, f. 18–23; viii. 36, 150, t. 27, f. 11, t. 28, f. 7, 8; 242, t. 50, f. 12, t. 51, f. 6 (*Contrib. Fossil Fl. W. Territories*, ii., iii.).

[5] Saporta, *Origine Paléontologique des Arbres*, 145. — Zittel, *Handb. Palæontolog.* ii. 409.

[6] Höhnel, *Die Gerberinden*, 52.

[7] *Nat. Dispens.* ed. 2, 286. — Johnson, *Man. Med. Bot. N. Am.* 252. — *U. S. Dispens.* ed. 16, 1728.

[8] In the fifth report of the United States Entomological Commission, published in 1890, one hundred and seventeen species of insects known to affect the Birches of eastern North America are recorded. Their number has already been considerably increased and there is probably still much to learn in regard to the insects which attack these trees in North America. Many of those found on the Birch also live upon Oaks, Alders, Willows, and other trees. No especially destructive indigenous borers have been noticed in the trunks of Betula in North America, although *Chrysobothris 6-signata*, Say, *Leptura vagans*, Olivier, and other Coleoptera sometimes injure the trunks. Of the numerous insects which feed upon the foliage of Betula few are known to be persistently injurious. The common Fall Web-worm, *Hyphantria cunea*, Drury, is one of the most troublesome, and several other species of Bombycidæ live upon the American Birches, but rarely appear on them in great numbers. Species of Noctuidæ are abundant on these trees, more than a dozen species belonging to the genus Apatela alone having been recorded. Tortricidæ are numerous, rolling and twisting the leaves in various ways, according to the species, and *Lithocolletis betulivora*, Walsingham, and other leaf-miners live within the parenchyma of the leaves.

Birch-trees are sometimes injured by Saw-flies like *Crœsus latitarsus*, Norton, and *Hylotoma dulciaria*, Say, which feed gregariously on the foliage; *Athysanus variabilis*, Fitch, and other Leaf-hoppers are often common upon Birches, and scale insects and aphids of various species sometimes damage them. *Callaphis betulella*, Walsh, has been described as abundant on *Betula nigra* in Illinois, and *Hormaphis papyraceæ*, Oestlund, forms long folds or corrugations between the veins of the leaves of the Canoe Birch. Minute galls, generally considered the work of Phytoptus, are sometimes found in large numbers on the leaves of some of the species, and a species of Phytoptus, or mite, arrests the growth of buds and twigs, causing them to become distorted, and forms large dense dark clusters or bunches in the trees. *Betula lenta* seems particularly liable to be affected in this way.

are fungal diseases very serious.[1] Several species are largely used in the northern United States and in Europe for the decoration of parks. Birch-trees can be easily raised from seeds,[2] and their varieties can be propagated by grafting.

Betula, the Latin name of the Birch, was adopted by Tournefort[3] and afterward by Linnæus for this genus.

The fruit of Betula is sometimes infested in America by a minute Dipteron identical with or closely allied to a species of Cecidomyia which in the larval state lives within the nuts of Birches in Europe.

[1] Betula abounds in fungi, several of which are peculiar to it and easily recognized. The most striking and familiar species is *Polyporus betulinus*, Fries, very common at all seasons of the year on the white-barked Birches. It forms flattened hemispherical or dish-like masses of a corky substance; at first these are nearly white but become brown with age, reaching sometimes a diameter of five or six inches and projecting at right angles to the trunks. The much larger, flatter, and harder fungus, *Polyporus applanatus*, Fries, from which ornamental brackets and so-called vegetable cameos are made, is also very common on the white-barked Birches, although it is also found on other trees. A number of the smaller species of Ascomycetes growing on Betula as *Hypoxylon transversum*, Saccardo, *Hypoxylon multiforme*, Fries, *Cenangium seriatum*, Fries, have the peculiarity of bursting through the bark in transverse lines similar to the elongated lenticels which form the familiar streaks in the bark of the Birch. *Diatrype disciformis*, Fries, dots the surface of the bark with numerous round black disks. Other Pyrenomycetes common on the Birches belong to the genera Hypoxylon, Massaria, and Melanconis, which are especially inclined to infest trees of this genus.

The leaves of Birches are attacked by *Melampsora betulina*, Tulasne, one of the rusts, and in early summer the leaves of *Betula populifolia* are not infrequently injured by *Exoascus flavus*, Farlow, which causes yellow discolorations. Later in the season the leaves are found to be covered with small black bodies, the perithecia of pycnidial forms belonging to a number of different Pyrenomycetes.

[2] Cobbett, *Woodlands*, 155.

[3] *Inst.* 588, t. 360.

CONSPECTUS OF THE NORTH AMERICAN SPECIES.

EUBETULA.

Strobiles oblong-ovoid, sessile or nearly so, erect; wing of the fruit not broader than the seed; bark brown or yellow-gray, and, like the young branches, aromatic.

Strobiles sessile, their scales glabrous; leaves ovate or oblong-ovate, heart-shaped or rounded at the base; bark dark brown, sweet-aromatic . . . . . 1. BETULA LENTA.

Strobiles sessile or short-stalked, their scales pubescent; leaves ovate or oblong-ovate, cuneate or slightly heart-shaped at the base; bark yellow or silvery gray, slightly aromatic . . . . . 2. BETULA LUTEA.

Strobiles cylindrical, on slender peduncles erect or hanging, the wing of the fruit broader than the seed.

Strobiles short or elongated; bark of young trunks and of the branches white on the outer surface, bright orange-color on the inner, and separable into thin sheets; young leaves and branchlets glandular.

Strobiles slender, short, erect or spreading, on short peduncles, their scales pubescent; staminate aments solitary or rarely in pairs; leaves nearly triangular, long-pointed, usually truncate at the broad base, lustrous, on elongated slender petioles; bark chalky white, rather close . . . . . 3. BETULA POPULIFOLIA.

Strobiles stout, elongated and hanging on long peduncles, their scales glabrous; staminate aments clustered; leaves ovate, cuneate or rounded at the base, dull dark green; bark lamellate, creamy white and lustrous . . . . . 4. BETULA PAPYRIFERA.

Strobiles oblong, erect, their scales pubescent; leaves rhombic-ovate, acute at both ends, lustrous; bark of young stems and upper branches separating in thin persistent plates . . . . . 5. BETULA NIGRA.

Strobiles short; bark close, dark brown, young leaves and branchlets glandular.

Strobiles oblong, erect or hanging on long slender peduncles, their scales puberulous; leaves thin and dull, broadly ovate, truncate or rounded at the base . . . . . 6. BETULA OCCIDENTALIS.

BETULA LENTA.

Cherry Birch. Black Birch.

STROBILES oblong-ovoid, glabrous, sessile, erect. Leaves ovate or oblong-ovate, heart-shaped or rounded at the base. Bark close, dark brown, sweet-aromatic.

Betula lenta, Linnæus, *Spec.* 983 (1753). — Miller, *Dict.* ed. 8, No. 3. — Muenchhausen, *Hausv.* v. 113. — Wangenheim, *Beschreib. Nordam. Holz.* 94. — Lamarck, *Dict.* i. 453. — Marshall, *Arbust. Am.* 19. — Schoepf, *Mat. Med. Amer.* 134. — Castiglioni, *Viag. negli Stati Uniti*, ii. 207. — Willdenow, *Berl. Baumz.* 41; *Spec.* iv. pt. i. 464; *Enum.* 981. — Persoon, *Syn.* ii. 572. — Wendland, *Coll.* t. 40. — Desfontaines, *Hist. Arb.* ii. 477. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 408. — Stokes, *Bot. Mat. Med.* iv. 368. — *Nouveau Duhamel*, iii. 205. — Michaux f. *Hist. Arb. Am.* ii. 147, t. 4. — Pursh, *Fl. Am. Sept.* ii. 621. — Bigelow, *Fl. Boston.* 231. — Nuttall, *Gen.* ii. 218. — Hayne, *Dendr. Fl.* 167. — Elliott, *Sk.* ii. 617. — Watson, *Dendr. Brit.* ii. 144, t. 144. — Sprengel, *Syst.* iii. 854. — Guimpel, Otto & Hayne, *Abbild. Holz.* 105, t. 83. — Hooker, *Fl. Bor.-Am.* ii. 156. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 190 (*Revisio Betulacearum*); *Hist. Vég.* xi. 241. — Torrey, *Fl. N. Y.* ii. 200, t. 113. — Emerson, *Trees Mass.* 203; ed. 2, i. 232, t. — Endlicher, *Gen.* Suppl. iv. pt. ii. 20. — Darlington, *Fl. Cestr.* ed. 3, 275. — Dietrich, *Syn.* v. 303. — Chapman, *Fl.* 428. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 74. — Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 125, t. 13, f. 15–18 (*Monographia Betulacearum*) (excl. vars. β and γ); *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 417 (*Gattungen Betula und Alnus*); *De Candolle Prodr.* xvi. pt. ii. 179 (excl. var. β). — K. Koch, *Dendr.* ii. pt. i. 639. — Ridgway, *Proc. U. S. Nat. Mus.* v. 85. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 162. — Lauche, *Deutsche Dendr.* ed. 2, 272. — Watson & Coulter, *Gray's Man.* ed. 6, 471. — Dippel, *Handb. Laubholzk.* ii. 185, f. 88. — Koehne, *Deutsche Dendr.* 107.

Betula nigra, Du Roi, *Obs.* 30 (not Linnæus) (1771); *Harbk. Baumz.* i. 93. — Wangenheim, *Nordam. Holz.* 35, t. 15, f. 34.

Betula carpinifolia, Ehrhart, *Beitr.* vi. 99 (1791). — Du Roi, *Harbk. Baumz.* ed. 2, i. 145. — Willdenow, *Enum.* 981; *Berl. Baumz.* ed. 2, 59. — Michaux, *Fl. Bor.-Am.* ii. 181.

A tree, seventy or eighty feet in height, with a trunk from two to five feet in diameter, and spicy aromatic bark and leaves. The bark of the trunk is from one half to three quarters of an inch in thickness, and dark brown slightly tinged with red; on old trunks it is dull, deeply furrowed, and broken into large thick irregular plates covered with closely appressed scales; and on young stems and on the branches it is close, smooth, and lustrous, and marked with elongated horizontal pale lenticels. The slender branches, which are much forked by the final growth of the short spur-like lateral branchlets, grow nearly upright on young plants, clothing the stem to the ground, and forming a symmetrical broad or narrow pyramid; when the tree is twenty or thirty feet high some of the upper branches begin to grow longer than those nearer the ground, and, spreading almost at right angles, and becoming pendulous toward their extremities, gradually form the comparatively narrow round-topped open graceful head which crowns the tall trunk of the Black Birch when it reaches maturity. The branchlets, when they first appear, are light green, slightly viscid, and pilose with scattered pale hairs; they soon begin to turn a dark orange-brown, and become rather lustrous during the summer, and in their first winter are bright red-brown, growing darker in their second year, and finally dark dull brown slightly tinged with red. The buds are fully grown at midsummer, when they are dark green and very lustrous, ovate, acute, and about a quarter of an inch long; they are covered with thin ovate acute scales, which in winter are light chestnut-brown, and rather loosely imbricated, those of the inner ranks being chartaceous and tipped with brown, and when fully grown, after the bud unfolds in the spring, from one half to three quarters of an inch long. The leaves are ovate or oblong-ovate, acute, or acuminate, gradually narrowed and often unequal at the cordate or rounded base, and sharply and doubly serrate with slender incurved callous-tipped teeth; when they unfold they are light green,

coated on the lower surface and the margins with long white silky hairs, and less thickly covered with pale hairs on the upper surface; and at maturity they are thin and membranaceous, dark dull green above, light yellow-green and furnished with small tufts of white hairs in the axils of the veins below, from two and a half to six inches long, and from an inch and a half to three inches wide, with yellow midribs and numerous primary veins indistinct on the upper surface, and hairy and prominent on the lower, and obscure reticulate cross veinlets; they are borne on stout hairy petioles, deeply grooved on the upper side, and from three quarters of an inch to an inch long, and late in the autumn before falling turn a bright clear yellow. The stipules are ovate, acute, light green, or nearly white, scarious, and ciliate above the middle on the margins with soft white hairs. During the winter the staminate catkins are about three quarters of an inch in length and nearly a quarter of an inch in thickness, with ovate acute apiculate scales, bright red-brown above the middle, and light brown below it; and when they are fully grown and the flowers open just before the unfolding of the leaves in early spring they are from three to four inches long, a quarter of an inch thick, and bright golden color in general appearance, although the tips of the scales are still brown. The pistillate catkins are from one half to three quarters of an inch long, and about an eighth of an inch thick, with ovate pale green scales rounded at the apex, and conspicuous light pink exserted styles. The strobiles, which are fully grown at midsummer, when they are dark green and lustrous, are oblong-ovoid, sessile, from an inch to an inch and a half in length and about half an inch thick; the scales are glabrous, with broad divergent rounded or acute lateral lobes. The nut is obovate, pointed at the base, rounded at the apex, and about as broad as its wing.

The Black Birch is distributed from Newfoundland and the valley of the Saguenay River to northwestern Ontario,[1] and southward through the northern United States to Delaware and southern Indiana and Illinois,[2] and along the Alleghany Mountains to western Florida and to central Kentucky and Tennessee. It grows on uplands, usually in rich soil, and is very abundant in Nova Scotia, New Brunswick, Quebec, and Ontario, where it attains a large size; it is one of the common forest trees in the northern states and on the Appalachian Mountains, growing to its greatest size on the western slopes of the Big Smoky Mountains in Tennessee.

The wood of *Betula lenta* is heavy, very strong, and hard, close-grained, with a satiny surface susceptible of receiving a beautiful polish; it is dark brown tinged with red, with thin light brown or yellow sapwood composed of seventy or eighty layers of annual growth, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.7617, a cubic foot weighing 47.47 pounds. It is largely used in the manufacture of furniture and for fuel, and in the maritime provinces of Canada in ship and boat building. From the wood an oil used medicinally and as a flavor is distilled,[3] and beer, which is probably also made from that of the other American species, is obtained by fermenting the sugary sap.[4]

What seems to be the earliest mention of the Black Birch appears in Josselyn's *New England*

[1] Brunet, *Cat. Vég. Lig. Can.* 53. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 55°. — Macoun, *Cat. Can. Pl.* 435.

[2] Ridgway, *Proc. U. S. Nat. Mus.* v. 85.

[3] The manufacture of Birch-oil is an important industry in several of the mountain counties of New Jersey and Pennsylvania. Young trees from ten to twenty-five feet in height are cut down, hauled to the distillery, and cut into pieces one or two inches long. These are put into large stills consisting of wooden boxes with copper bottoms, macerated in water, and distilled with a wood fire. The vapor is carried into a copper or tin worm placed in a barrel and cooled by cold water from a mountain stream. The steam condenses and flows from the coil as mixed oil and water, and the oil, being the heavier, settles in the bottom of the receiver. An average of about four pounds of oil is obtained from one ton of wood, the largest yield being in April and May. The oil of Birch is identical in flavor, perfume, and chemical constituents with that obtained from *Gaultheria procumbens*, Linnæus; it contains a large percentage of salicylic acid, and has been employed as a remedy for rheumatism. It was most largely used, however, as an aromatic stimulant, and as a flavoring agent, generally under the name of wintergreen oil, until replaced by the artificial oil of wintergreen made from salicylic acid and wood-alcohol, which has now largely replaced it, except in medicinal uses (Kennedy, *Am. Jour. Pharm.* ser. 4, xii. 49; xiv. 85. — Johnson, *Man. Med. Bot. N. Am.* 252. — Breisch, *Am. Jour. Pharm.* lxiii. 579. — *U. S. Dispens.* ed. 16, 1728. — Trimble, *Garden and Forest*, viii. 303).

[4] Porcher, *Resources of Southern Fields and Forests*, 265.

Rarities,[1] published in London in 1672. It was first described by Clayton in his *Flora Virginica* in 1739.[2]

The Black Birch,[3] which is a handsome tree with its tall dark stem, graceful fragrant branches, and healthy dark green foliage, is especially beautiful in early spring when its long staminate aments hang from the leafless branches, changing them for a few days into fountains of golden spray, and making it the most conspicuous of the American Birches.

[1] "*Birch*, white and black; the bark of Birch is used by the *Indians* for bruised Wounds and Cuts, boyled very tender, and stampt betwixt two stones to a Plaister, and the decoction thereof poured into the Wound; And also to fetch the Fire out of Burns and Scalds." (Josselyn, *New England Rarities*, 51.)

"The Birch-tree is of two kinds, ordinary Birch, and black Birch, many of these Trees are stript of their bark by the *Indians*, who make of it their Canows, Kettles, and Birchen-dishes." (Josselyn, *An Account of Two Voyages to Virginia*, 69.)

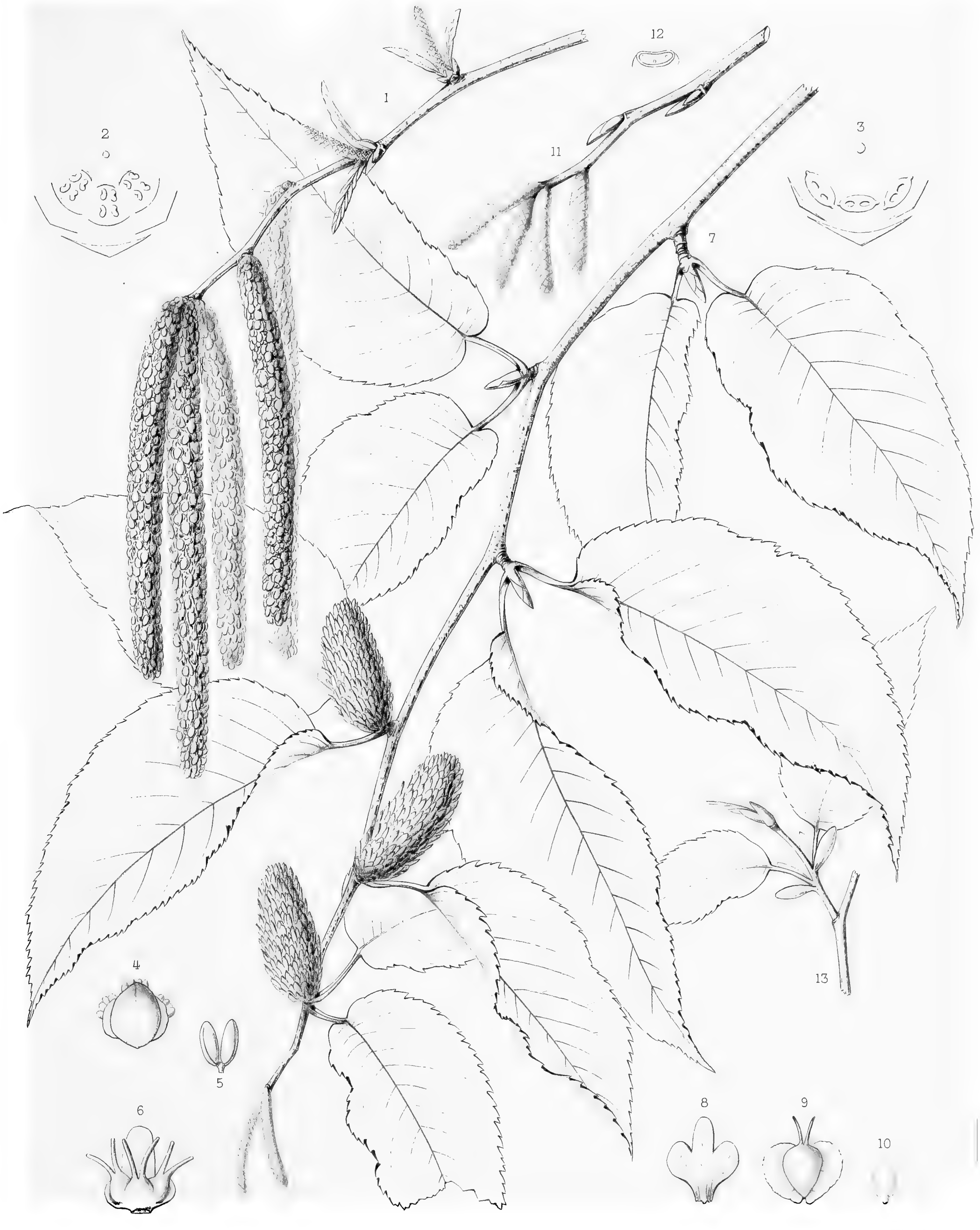
[2] *Betula julifera fructu conoide, viminibus lentis*, 115.

[3] *Betula lenta* is sometimes also called Sweet Birch and Mahogany Birch.

EXPLANATION OF THE PLATE.

PLATE CCCCXLVIII. BETULA LENTA.

1. A flowering branch, natural size.
2. Diagram of a cluster of staminate flowers.
3. Diagram of a cluster of pistillate flowers.
4. Scale of a staminate ament, rear view, enlarged.
5. A stamen, enlarged.
6. Pistillate flowers with their scale, front view, enlarged.
7. A fruiting branch, natural size.
8. Scale of a strobile, enlarged.
9. A nut, enlarged.
10. An embryo, enlarged.
11. A winter branch with staminate aments, natural size.
12. A leaf-scar, enlarged.
13. A young branchlet with unfolding bud and stipules, natural size.



C.E.Faxon del.

Himely sc.

BETULA LENTA.L.

A.Riocreux direx.t

Imp. J.Taneur, Paris.

BETULA LUTEA.

Yellow Birch. Gray Birch.

STROBILES oblong-ovoid, sessile, or short-stalked. Leaves ovate, oblong-ovate, cuneate, or slightly heart-shaped at the base. Bark yellow or silvery gray, slightly aromatic.

Betula lutea, Michaux f. *Hist. Arb. Am.* ii. 152, t. 5 (1812). — Spach, *Ann. Sci. Nat.* sér. 2, xv. 191 (*Revisio Betulacearum*); *Hist. Vég.* xi. 243. — Endlicher, *Gen.* Suppl. iv. pt. ii. 20. — K. Koch, *Dendr.* ii. pt. i. 640. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 161. — Lauche, *Deutsche Dendr.* ed. 2, 272. — Watson & Coulter, *Gray's Man.* ed. 6, 471. — Dippel, *Handb. Laubholzk.* ii. 184, f. 87.

Betula excelsa, Pursh, *Fl. Am. Sept.* ii. 621 (not Aiton) (1814). — Nuttall, *Gen.* ii. 218. — Sprengel, *Syst.* iii. 854. — Hooker, *Fl. Bor.-Am.* ii. 156. — Bigelow, *Fl. Boston.* ed. 3, 382. — Torrey, *Fl. N. Y.* ii. 200. — Gray, *Man.* 422. — Emerson, *Trees Mass.* 206; ed. 2, i. 235, t. — Dietrich, *Syn.* v. 303. — Chapman, *Fl.* 428. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 74.

Betula lenta, *α* **genuina**, Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 125 (*Monographia Betulacearum*) (in part) (1860).

Betula lenta, *β* **lutea**, Regel, *De Candolle Prodr.* xvi. pt. ii. 179 (1868). — Koehne, *Deutsche Dendr.* 107.

A tree, occasionally one hundred feet high, with a trunk three or four feet in diameter; or, in the neighborhood of the coast and toward the southern and the extreme northwestern limits of its range, much smaller and often not more than twenty or thirty feet in height. The bark, which is aromatic and slightly bitter, is about half an inch thick on old trunks, reddish brown, and divided by narrow irregular fissures into large thin plates covered with minute closely appressed scales; on young trunks it is much thinner, bright silvery gray, or light orange-colored, very lustrous, and close and firm or somewhat divided, the edges of the irregular fissures breaking into thin layers; on the branches it is thin, separating freely into large persistent papery scales more or less rolled on the borders. The branches are long and usually comparatively slender, although large individuals often produce several stout limbs; on young plants they grow at first perpendicularly or spread slightly, and form a broad-based pyramid; but as some of the upper branches develop more vigorously than those near the ground, the tree begins to form the broad round-topped head of spreading and more or less pendulous branches which distinguishes it when it has reached its prime. When they first appear the branchlets are green and covered with long pale hairs, and during their first summer are light orange-brown and pilose; during their first winter they are glabrous, and light brown slightly tinged with orange or often flushed with red on the side exposed to the sun; in their second season they are dark orange-brown and lustrous, and then gradually grow darker and lose their lustre. The buds are about a quarter of an inch long, dull green, somewhat viscid, and covered with loose pale hairs during the summer; and in winter they are light chestnut-brown, acute, and slightly puberulous. The leaves are ovate or oblong-ovate, acuminate or acute at the apex, gradually narrowed to the rounded cuneate or rarely heart-shaped usually oblique base, sharply doubly serrate with incurved or spreading gland-tipped teeth, and slightly aromatic; as they unfold they are conspicuously plicate, bronze green or red, and pilose with long pale hairs on the upper surface and on the under side of the midribs and veins, and at maturity they are dark dull green above, yellow-green below, from three to four and a half inches long, and from an inch and a half to two inches wide, with stout midribs and numerous primary veins impressed above and covered below, especially near the base of the leaf and in the axils of the veins, with short pale or rufous hairs; they are borne on slender pale yellow hairy grooved petioles from three quarters of an inch to an inch in length, and turn to a clear bright yellow color in the autumn before falling. The

stipules are ovate, acute, light green, tinged with pink above the middle, and about half an inch long, and soon turn brown and fall after the unfolding of the leaf. The staminate aments are from three quarters of an inch to an inch long, and about an eighth of an inch thick during the winter, with ovate rounded scales light chestnut-brown and lustrous above the middle, and ciliate on the margins; and when the flowers open in early spring they are from three to three and a half inches in length, and a third of an inch in thickness, their scales being then pale yellow-green below the middle and dark brown above. The pistillate catkins are about two thirds of an inch long, with acute scales pale green below, light red and tipped with clusters of long white hairs at the apex, and pilose on the back. The strobiles, which ripen late in the autumn, are erect, sessile, or short-stalked, oblong-ovoid, from an inch to an inch and a half in length, and about three quarters of an inch in thickness, and are covered by broad or narrow wedge-shaped scales pubescent on the back, especially toward the base, and irregularly and sometimes equally three-lobed at the apex with acute or rounded lobes. The nut is oval or obovate, and about an eighth of an inch long, with a wing rather narrower than the seed.

The Yellow Birch, which is one of the largest deciduous-leaved trees of the northern forests of northeastern North America, is distributed from Newfoundland along the northern shores of the Gulf of St. Lawrence to those of Abittibi Lake and the valley of Rainy River,[1] and southward through the northern states to northern Delaware, along the Alleghany Mountains to the high peaks of North Carolina and Tennessee, and to northern Minnesota. It usually inhabits moist uplands, growing in rich soil, and is exceedingly abundant, and attains its largest size in the eastern provinces of Canada and in northern New England and New York; in Ontario it is smaller, and in southern New England and southward it is usually rare and a small tree; in the southern states it occurs only near the summits of the high mountains, and is stunted and often shrubby in habit.

Betula lutea is one of the most valuable timber-trees of the north. The wood is heavy, very strong, hard, and close-grained, with a satiny surface susceptible of receiving a beautiful polish; it is light brown tinged with red, with thin nearly white sapwood,[2] and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.6553, a cubic foot weighing 40.84 pounds. It is largely used in the manufacture of furniture, of button and tassel moulds, pill and match boxes, and the hubs of wheels, and for fuel.

The Yellow Birch, as it grows among the Pines, Maples, and Elms of the northern forest, is often a magnificent object with its great trunk, lustrous bark, and broad head of graceful branches, but it requires low temperatures and abundant moisture to develop its beauty, and even in southern New England it is rarely a handsome tree.

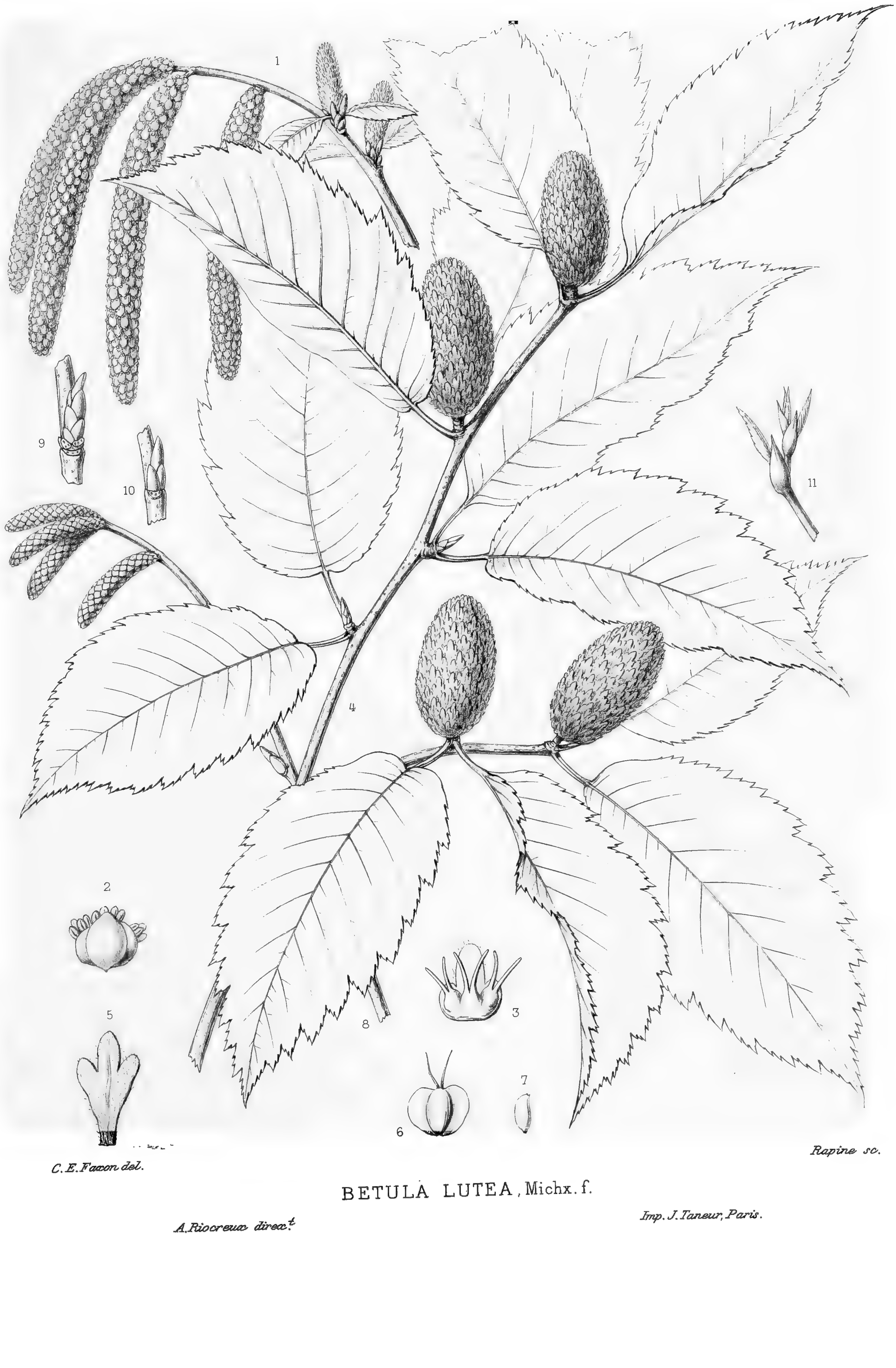
[1] Brunet, *Cat. Vég. Lig. Can.* 53. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 50°. — Macoun, *Cat. Can. Pl.* 436.

[2] The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut in northern New York, is twenty-three and a half inches in diameter inside the bark, and is three hundred and six years old, with two and a half inches of sapwood composed of seventy-six layers of annual growth.

EXPLANATION OF THE PLATE.

PLATE CCCCXLIX. BETULA LUTEA.

1. A flowering branch, natural size.
2. Scale of a staminate ament, rear view, enlarged.
3. Pistillate flowers with their scale, front view, enlarged.
4. A fruiting branch, natural size.
5. Scale of a fruiting ament, enlarged.
6. A nut, enlarged.
7. A seed, enlarged.
8. A winter branch with staminate aments, natural size.
9. A fertile winter-bud, and leaf-scars, enlarged.
10. A sterile winter-bud, enlarged.
11. End of a young branchlet with stipules and unfolding leaves, natural size.



C. E. Faxon del.

Rapine sc.

BETULA LUTEA, Michx. f.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

BETULA POPULIFOLIA.

Gray Birch. White Birch.

STROBILES cylindrical, short, erect or spreading, short-stalked. Staminate catkins usually solitary. Leaves triangular, long-pointed, usually truncate at the broad base, lustrous, the petioles slender and elongated.

Betula populifolia, Marshall, *Arbust. Am.* 19 (1785). — Du Roi, *Harbk. Baumz.* ed. 2, i. 144. — Willdenow, *Berl. Baumz.* 37, t. 2, f. 5; *Spec.* iv. pt. i. 463. — Borkhausen, *Handb. Forstbot.* i. 502. — Persoon, *Syn.* ii. 572. — Desfontaines, *Hist. Arb.* ii. 476. — Poiret, *Lam. Dict.* Suppl. i. 687. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 408. — *Nouveau Duhamel*, iii. 204. — Michaux f. *Hist. Arb. Am.* ii. 139, t. 2. — Pursh, *Fl. Am. Sept.* ii. 620. — Bigelow, *Fl. Boston.* 231. — Nuttall, *Gen.* ii. 218; *Sylva*, i. 25. — Hayne, *Dendr. Fl.* 166. — Sprengel, *Syst.* iii. 854. — Watson, *Dendr. Brit.* ii. 151, t. 151. — Hooker, *Fl. Bor.-Am.* ii. 155. — Torrey, *Fl. N. Y.* ii. 199, t. 112. — Emerson, *Trees Mass.* 213; ed. 2, i. 243, t. — Dietrich, *Syn.* v. 303. — K. Koch, *Dendr.* ii. pt. i. 646. — Lauche, *Deutsche Dendr.* ed. 2, 274. — Watson & Coulter, *Gray's Man.* ed. 6, 471. — Dippel, *Handb. Laubholzk.* ii. 171. — Koehne, *Deutsche Dendr.* 110.

Betula lenta, Du Roi, *Harbk. Baumz.* i. 92 (not Linnæus) (1771).

Betula excelsa Canadensis, Wangenheim, *Nordam. Holz.* 86 (1787).

Betula acuminata, Ehrhart, *Beitr.* vi. 98 (excl. syn.) (1791). — Moench, *Meth.* 693.

Betula alba, β populifolia, Spach, *Ann. Sci. Nat.* sér. 2, xv. 187 (*Revisio Betulacearum*) (1841); *Hist. Vég.* xi. 233. — Endlicher, *Gen.* Suppl. iv. pt. ii. 19. — Gray, *Man.* ed. 2, 411. — Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 76, t. 4, f. 19–29 (*Monographia Betulacearum*). — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 159.

Betula alba, subsp. **populifolia**, Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 399 (*Gattungen Betula und Alnus*) (1865); *De Candolle Prodr.* xvi. pt. ii. 164.

A short-lived tree, twenty or thirty or exceptionally forty feet in height, with a trunk rarely eighteen inches in diameter, and short slender often pendulous more or less contorted branches which usually clothe the stem to the ground and form a narrow pyramidal pointed head, often growing in clusters of spreading stems which spring from the stumps of older trees. The bark of the trunk is about a third of an inch in thickness, dull chalky white on the outer surface and bright orange on the inner, usually close and firm, although easily separable into thin plates with dark triangular markings at the insertion of the branches; at the base of large trees it is thicker, nearly black, and irregularly broken by shallow fissures. The branchlets are slender and roughened by small crowded raised lenticels, and, when they first appear, are resinous-glandular like the unfolding leaves; they gradually grow darker and the lenticels become light orange-colored; before autumn they are dark orange-yellow and lustrous, like the young stems, and during the first winter are bright reddish brown, and then growing dark brown ultimately become white near the trunk. The leaves are nearly triangular, acuminate and long-pointed at the apex, and coarsely doubly serrate with stout spreading glandular teeth except at the broad truncate or slightly obcordate or wedge-shaped base; they are thin and firm in texture, dark green, lustrous, and somewhat roughened on the upper surface early in the season by small pale glands in the axils of the conspicuous reticulate veinlets, from two and a half to three inches in length and from an inch and a half to two inches and a half in width, with stout yellow midribs marked with minute black glands and raised and rounded on the upper side and few yellow obscure primary veins rounded and conspicuous above; they are borne on slender terete petioles covered with black glands, often stained with red on the upper side, and from three quarters of an inch to an inch long, and flutter with the slightest breath of wind; in the autumn before falling they turn pale yellow. The stipules are broadly ovate, acute, membranaceous, and light green slightly tinged with red. The aments of staminate flowers, which are

usually solitary or rarely in pairs, vary during the winter from an inch and a quarter to an inch and a half in length and are about an eighth of an inch thick; and when fully grown and the flowers open in early spring they are from two and a half to four and a half inches long, with ovate acute apiculate scales. The pistillate aments are slender and about half an inch long, with ovate acute pale green glandular scales, and are raised on slender glandular peduncles almost a third of an inch in length and furnished near the middle and toward the apex with conspicuous ovate acute scarious bractlets. The strobiles are cylindrical, obtuse at the apex, and about three quarters of an inch long, and hang upon slender peduncles of about the same length; the scales, which are usually broader than long, are coated on the back with thick pale pubescence, and are cuneate at the base, with broad diverging lateral lobes. The nut is oval or obovate, acute or rounded at the base, and furnished with obovate wings rather broader than the seed.

Betula populifolia, which is the smallest and least widely distributed of the Birch-trees of eastern North America, inhabits Nova Scotia, New Brunswick, and the valley of the lower St. Lawrence River,[1] and ranges southward, usually in the neighborhood of the coast, to Newcastle County, Delaware, and westward through northern New England and New York, ascending sometimes to altitudes of eighteen hundred feet above the level of the sea, to the southern shores of Lake Ontario. Rare and comparatively local in the interior, the Gray Birch, which grows on dry gravelly barren soil, or sometimes, especially in southern New England and southward, on the moist margins of swamps and ponds, is extremely abundant in the coast regions of New England and the middle states, springing up profusely on abandoned farm lands and on those which have been stripped by fire of their forest covering.

The wood of *Betula populifolia* is light, soft, not strong, close-grained, liable to check badly in drying, and not durable in contact with the ground; it is light brown, with thick nearly white sapwood, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.5760, a cubic foot weighing 35.90 pounds. It is largely used in the manufacture of spools, shoe-pegs, and wood-pulp, and for the hoops of barrels. It makes excellent fuel, burning with a clear bright flame, the resinous bark igniting quickly.

Betula populifolia,[2] with its pale bark and its lustrous leaves fluttering on their long stems as freely as those of the Aspen, is an interesting and sometimes a picturesque object. The short life of this tree, however, and the flexibility of its slender trunks, which are often bent to the ground and injured by ice and snow, make it one of the least desirable of American trees for the decoration of parks; and its greatest utility lies in its power to spring up profusely and grow rapidly in sterile soil and in the protection it affords to the seedlings of more valuable but more slowly growing trees.

[1] Brunet, *Cat. Vég. Lig. Can.* 52. — Macoun, *Cat. Can. Pl.* 436.

[2] *Betula populifolia* is also sometimes called Old Field Birch.

EXPLANATION OF THE PLATE.

PLATE CCCCL. BETULA POPULIFOLIA.

1. A flowering branch, natural size.
2. Scale of a staminate ament, rear view, enlarged.
3. Scale of a staminate ament with bract and bractlets, the flowers removed, enlarged.
4. A stamen, enlarged.
5. Pistillate flowers with their scale, front view, enlarged.
6. A fruiting branch, natural size.
7. Scale of a fruiting ament, enlarged.
8. A nut, enlarged.
9. An embryo, enlarged.
10. A winter branch with staminate ament, natural size.
11. A sterile winter-bud, enlarged.
12. The end of a branch with unfolding leaves and stipules, natural size.

C.E.Faxon del. *Himely sc.*

BETULA POPULIFOLIA, Marsh.

A.Riocreux direx.t *Imp.J.Taneur, Paris.*

BETULA PAPYRIFERA.

Canoe Birch. Paper Birch.

STROBILES cylindrical, elongated, pendulous, long-stalked. Staminate aments clustered or in pairs. Leaves ovate, cuneate, or rounded at the base, dull dark green.

Betula papyrifera, Marshall, *Arbust. Am.* 19 (1785). — Borkhausen, *Handb. Forstbot.* i. 504. — Michaux, *Fl. Bor.-Am.* ii. 180. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 159. — Watson & Coulter, *Gray's Man.* ed. 6, 472.

Betula lenta, Wangenheim, *Nordam. Holz.* 45 (not Linnæus) (1787).

Betula papyracea, Aiton, *Hort. Kew.* iii. 337 (1789). — Willdenow, *Berl. Baumz.* 40, t. 2, f. 1; *Spec.* iv. pt. i. 464; *Enum.* 981. — *Nouveau Duhamel*, iii. 205. — Persoon, *Syn.* ii. 572. — Desfontaines, *Hist. Arb.* ii. 477. — Poiret, *Lam. Dict.* Suppl. i. 688. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 408. — Michaux f. *Hist. Arb. Am.* i. 133, t. 1. — Pursh, *Fl. Am. Sept.* ii. 621. — Nuttall, *Gen.* ii. 218; *Sylva*, i. 25. — Hayne, *Dendr. Fl.* 167. — Bigelow, *Fl. Boston.* ed. 2, 355. — Watson, *Dendr. Brit.* ii. 152, t. 152. — Sprengel, *Syst.* iii. 854. — Audubon, *Birds*, t. 88. — Hooker, *Fl. Bor.-Am.* ii. 155. — Emerson, *Trees Mass.* 210; ed. 2, i. 239, t. — Gray, *Man.* 422. — Dietrich, *Syn.* v. 303. — K. Koch, *Dendr.* ii. pt. i. 645. — Lauche, *Deutsche Dendr.* ed. 2, 274. — Dippel, *Handb. Laubholzk.* ii. 177. — Koehne, *Deutsche Dendr.* 110.

? **Betula excelsa**, Aiton, *Hort. Kew.* iii. 337 (1789). — Willdenow, *Berl. Baumz.* 41, t. 2, f. 2; *Spec.* iv. pt. i. 463. — Borkhausen, *Handb. Forstbot.* i. 506. — *Nouveau Duhamel*, iii. 203, t. 52. — Persoon, *Syn.* ii. 572. — Desfontaines, *Hist. Arb.* iv. 477. — Poiret, *Lam. Dict.* Suppl. i. 687. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 408. — Hayne, *Dendr. Fl.* 167. — Watson, *Dendr. Brit.* ii. 95, t. 95. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 188 (*Revisio Betulacearum*); *Hist. Vég.* xi. 243. — Endlicher, *Gen.* Suppl. iv. pt. ii. 19.

Betula alba, ε **papyrifera**, Spach, *Ann. Sci. Nat.* sér. 2, xv. 188 (*Revisio Betulacearum*) (1841); *Hist. Vég.* xi. 234. — Endlicher, *Gen.* Suppl. iv. pt. ii. 19. — Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 81, t. 5, f. 5–16 (*Monographia Betulacearum*).

Betula cordifolia, Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 86, t. 12, f. 29–36 (*Monographia Betulacearum*) (1860).

Betula occidentalis, Lyall, *Jour. Linn. Soc.* vii. 134 (not Hooker) (1864).

Betula alba, subsp. 5. β **commutata**, Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 401, t. 7, f. 6–10 (*Gattungen Betula und Alnus*) (1865); *De Candolle Prodr.* xvi. pt. ii. 166.

Betula alba, subsp. 6. α **communis**, Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 401 (*Gattungen Betula und Alnus*) (1865); *De Candolle Prodr.* xvi. pt. ii. 166.

Betula alba, subsp. 6. β **cordifolia**, Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 401 (*Gattungen Betula und Alnus*) (1865); *De Candolle Prodr.* xvi. pt. ii. 166.

Betula Ermani, Rothrock, *Smithsonian Rep.* 1867, 454 (*Fl. Alaska*) (not Chamisso) (1868).

Betula alba var. **populifolia**, Winchell, *Ludlow's Rep. Black Hills Dakota*, 67 (not Spach) (1875).

Betula papyracea, a **cordifolia**, Dippel, *Handb. Laubholzk.* ii. 177 (1892).

Betula papyracea, b **occidentalis**, Dippel, *Handb. Laubholzk.* ii. 177, f. 84 (1892). — Koehne, *Deutsche Dendr.* 110.

A tree, usually sixty or seventy, or, on the northwest coast, occasionally one hundred and twenty feet tall, with a trunk from two to three feet in diameter and clothed while young with short slender spreading branches with elongated lateral branchlets forking at acute angles, more or less drooping at the extremities, and forming a regular narrow pyramidal rather compact head; or in old age, or when crowded by other trees, with a branchless trunk supporting a narrow round-topped open airy head of pendulous branches; or on the mountains of northern New England sometimes reduced at high elevations to a shrub or small tree with smaller and less elongated leaves and smaller fruit.[1] The bark on old trunks for a few feet above the ground is sometimes half an inch thick, dark brown or nearly black, sharply and irregularly furrowed, and broken on the surface into thick closely appressed scales,

[1] *Betula papyrifera*, var. *minor*, Watson & Coulter, *Gray's Man.* ed. 6, 472 (1890). — *Betula papyracea*, β *minor*, Tuckerman, *Am. Jour. Sci.* xlv. 31 (1843).

and at the base of younger trees it is brown tinged with red, and separates irregularly into large plates covered with thin and sometimes silvery scales. Higher on the trunks of old trees, which like the base of the large branches are nearly surrounded by broad irregular horizontal nearly black bands, on young stems and on the large limbs, the bark is thin, creamy white and lustrous on the outer surface, bright orange-color on the inner, marked with long narrow horizontal slightly darker colored raised lenticels, and separates freely into thin papery layers which, when first exposed to the light, are pale orange-color. The branchlets are slender, and, when they first appear, are light green, slightly viscid, marked with scattered orange-colored oblong lenticels, and covered with long pale hairs; through the summer they are dark orange-color and glabrous or pubescent, and conspicuously marked with pale lenticels; during the first winter they are dull red, growing gradually a darker orange-brown and more lustrous for the next four or five years, and are then covered with the white papery bark of the older branches. The buds, when they are fully grown at midsummer, are ovate, acute, and about a quarter of an inch long, dark green, pubescent below the middle, and coated with resinous gum, and during the winter they are dark chestnut-brown, glabrous, and slightly resinous; in expanding, the inner scales, which are light brown and scarious, become strap-shaped, rounded at the apex, about half an inch in length and an eighth of an inch in breadth. The leaves are ovate, rather abruptly acuminate at the apex with short broad points, and coarsely, usually doubly and often very irregularly serrate with nearly triangular callous spreading teeth, except at the rounded or slightly cordate or abruptly wedge-shaped base; when they unfold they are bright green, glandular-resinous, pubescent, and clothed below on the midribs and primary veins, and on the petioles, with long white hairs; at maturity they are thick and firm in texture, dull dark green on the upper surface, which is glandless or rarely marked, especially while young, with minute pale glands, and light yellow-green and glabrous or puberulous on the lower surface, which is furnished with small tufts of pale hairs in the axils of the primary veins, and is coated with minute black glands; they are from two to three inches long, and from one and a half to two inches wide, with slender yellow midribs raised and rounded on the upper side and marked, like the few remote prominent primary veins, with minute black glands, and conspicuous reticulate veinlets; they are borne on stout yellow petioles covered with black glands, much enlarged toward the base, flattened and obscurely grooved on the upper side, glabrous or pubescent, and from one half to three quarters of an inch in length, and turn a light clear yellow in the autumn before falling. The stipules are ovate, acute, ciliate on the margins with pale hairs, light green, and caducous. During the winter the staminate catkins, which are produced in two or three-flowered clusters, are from three quarters of an inch to an inch and a quarter in length, and about an eighth of an inch in thickness, with ovate acute nearly triangular slightly apiculate puberulous scales, light brown below the middle and dark red-brown above; and when they are fully grown, and the flowers open in early spring, they are from three and a half to four inches long and about a third of an inch thick. The pistillate catkins are from an inch to an inch and three quarters long, and about a sixteenth of an inch thick, with light green lanceolate scales, long-pointed and acute or rounded at the apex, and bright red styles; they are borne on slender glandular peduncles, bibracteolate with conspicuous acute scarious caducous bractlets, and from three quarters of an inch to an inch in length. The strobiles, which hang on slender stalks, are cylindrical, and about an inch and a half long and a third of an inch thick; their scales are glabrous, or rarely puberulous, cuneate at the base, and rather longer than broad, with short wide-spreading rounded lateral lobes. The nut is oval, about a sixteenth of an inch in length, and much narrower than its thin wing.

The Canoe Birch is one of the most widely distributed trees of North America. From Labrador it ranges to the southern shores of Hudson's Bay and to those of the Great Bear Lake, and to the valley of the Yukon River and the coast of Alaska, forming with the Aspen, the Larch, the Balsam Poplar, the Banksian Pine, the Black and the White Spruces, and the Balsam Fir, the great sub-arctic transcontinental forest; and southward it ranges through all the forest region of the Dominion

of Canada[1] and the northern states to Long Island, New York, and northern Pennsylvania, central Michigan and Minnesota, the bluffs of the Niobrara River in northern Nebraska,[2] the Black Hills of Dakota,[3] northern Montana, and northwestern Washington.[4] An inhabitant of rich woody slopes and the borders of streams, lakes, and swamps, the Canoe Birch, although it never forms a large part of the forest, is very common in the maritime provinces of Canada, in the region immediately north of the Great Lakes, and in northern New England and New York, where it ascends to higher elevations than any other deciduous-leaved tree; it is small and comparatively rare in the coast region of southern New England, in southern New York, and in central Minnesota; widely distributed at high latitudes from Labrador to the eastern base of the Rocky Mountains, it is never very abundant here or a conspicuous object in the landscape, and within the Arctic Circle becomes small and crooked; west of the Rocky Mountains, where it attains its largest size, the Canoe Birch usually grows singly, and is found only along the banks of streams.

The wood of *Betula papyrifera* is light, strong, hard, tough, and very close-grained; it is light brown tinged with red, with thick nearly white sapwood, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.5955, a cubic foot weighing 37.11 pounds. It is largely used in the making of spools, for which purpose it is preferred to the wood of other American trees, and of shoe-lasts and pegs, in turnery, in the manufacture of wood-pulp, and for fuel. The Indians of the north employ it for their sledges and paddles, the frames of their snow-shoes, and the handles of their hatchets. The tough resinous durable bark of this tree, easily separated into thin layers, and impervious to water, is indispensable to all the northern tribes of Indians; with it they build their canoes and manufacture baskets, bags, drinking-cups, and many other articles of domestic use; and when the skins of large animals cannot be obtained, it protects their wigwams from the inclemency of the boreal winter.[5]

The sweet sap, which flows freely in early spring from wounds made in the trunk of the Canoe Birch, furnishes the Indians with a pleasant cooling drink, or by boiling can be made into syrup.[6]

According to Aiton,[7] *Betula papyrifera* was introduced in 1750 by the Duke of Argyll[8] into English plantations.

[1] Brunet, *Cat. Vég. Lig. Can.* 52. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 45°. — Macoun, *Cat. Can. Pl.* 436; *Trans. Roy. Soc. Can.* xii. 5.

[2] Bessey, *Rep. Nebraska State Board Agric.* 1894, 110.

[3] Williams, *Bull.* No. 43, *South Dakota Agric. College*, 108.

[4] In 1882 *Betula papyrifera* was collected near Seattle, Washington, by Mr. C. V. Piper.

The western form of this tree differs from the eastern in its greater height and rather darker colored bark, in its more pubescent branchlets, which sometimes do not become glabrous until their second season, although vigorous shoots of young plants in the east are often clothed with thick pubescence, and in its rather larger leaves, which, on the lower surface, are also more pubescent.

[5] "Birch, of this there is plenty in divers parts of the Country. Of the barck of these the Salvages of the Northerne parts make them delicate Canowes, so light, that two men will transport one of them over Land whether they list, and one of them will transporte tenne or twelve Salvages by water at a time." (Morton, *New English Canaan*, 45 [Force, *Coll. Hist. Tracts*, ii. No. 5].)

"Ceux-ci sont sûres & ne tournent jamais quand ils sont d'écorce de *Bouleau*, laquelle se leve ordinairement en hiver avec de l'eau chaude. Les plus gros arbres sont les meilleurs pour faire de grands Canots; quoique souvent une seule écorce ne suffise pas. Le fond est pourtant d'une seule piéce auquel les Sauvages sçavant coudre si artistement les bords avec des racines, que le Canot paroît d'une seule écorce. Ils sont garnis ou de clisses & de varangues d'un bois de cédre presque aussi leger que le liége. Les clisses ont l'épaisseur d'un écu; l'écorce, celle de deux, & les varangues celle de trois. Outre cela il regne à droit & à gauche d'un bout du Canot à l'autre deux Maîtres ou precintes dans lesquels sont enchassées les pointes des varangues & où les huit barres qui le lient & le traversent sont attachées. Ces bâtiments ont 20. pouces de profondeur, c'est-à-dire des bords jusqu'au plat des varangues; ils ont 28. pieds de longueur & 4. & demi de largeur vers la barre du milieu. S'ils sont commodes par leur grande legereté & par le peu d'eau qu'ils tirent, il faut avoüer, qu'ils sont en recompense bien incommodes, par leur fragilité; car pour peu qu'ils touchent ou chargent sur le caillou ou sur le sable, les crevasses de l'écorce s'entrouvrent, ensuite l'eau entre dedans, & mouille les vivres & les Marchandises. Chaque jour il y a quelque nouvelle crevasse ou quelque couture à gommer. Toutes les nuits on est obligé de le décharger à flot, & de les porter à terre, où on les attache à des piquets de peur que le vent ne les emporte; car ils pesent si peu que deux hommes les portent à leur aise sur l'épaule, chacun par un bout. Cette seule facilité me fait juger qu'il n'y a point de meilleure voiture au monde pour naviguer dans les Rivieres du *Canada* qui sont remplies de Cascades, de Cataractes & de courans." (Lahontan, *Nouveaux Voyages dans l'Amérique*, i. 35.)

[6] Richardson, *Arctic Searching Exped.* ii. 310.

[7] *Hort. Kew.* iii. 337. — Loudon, *Arb. Brit.* iii. 1708, f. 1561, t.

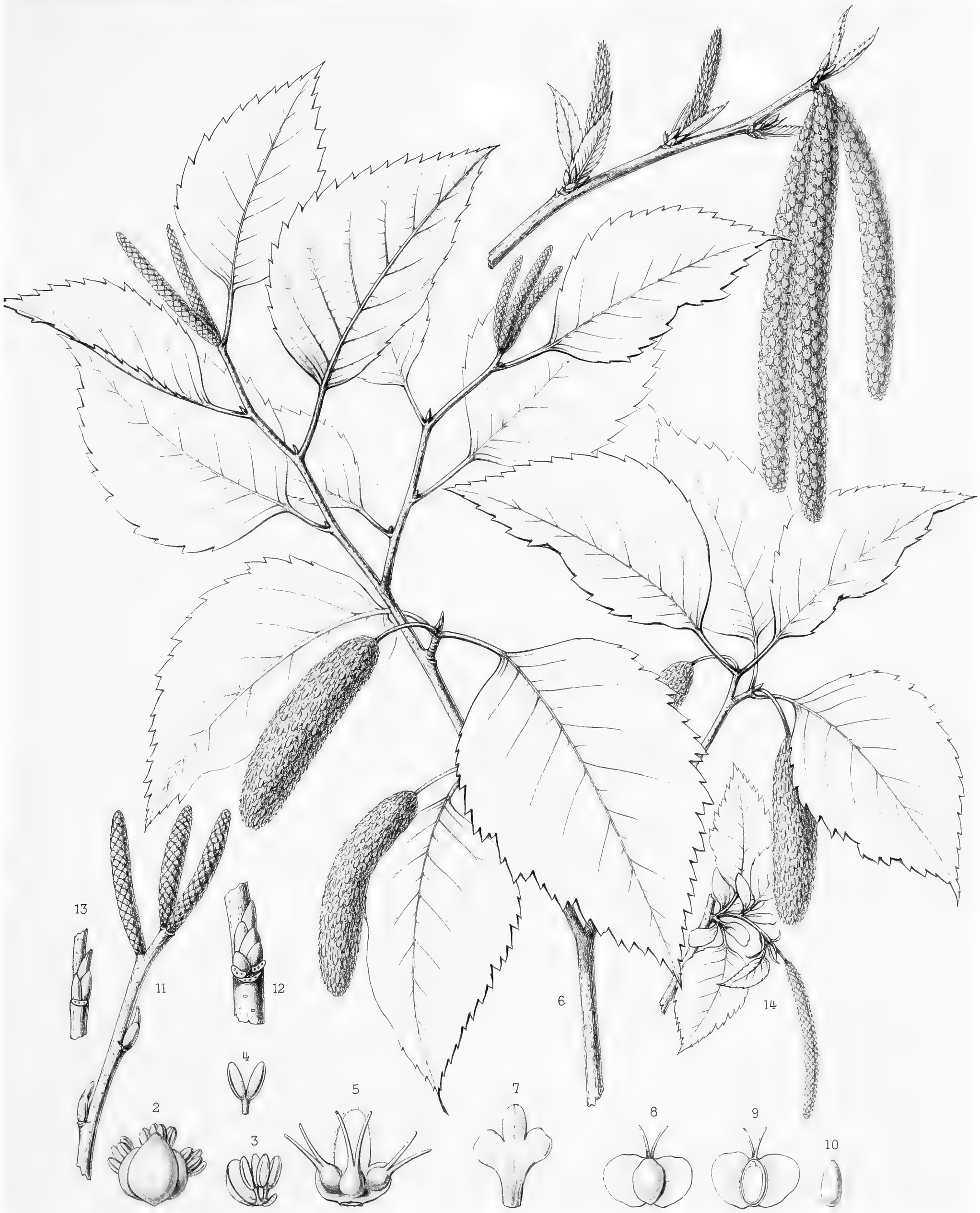
[8] See i. 108.

With its gleaming white trunk and luxuriant dark foliage, its compact symmetrical habit in youth, and the open airy and graceful head which it bears at maturity, the Canoe Birch is always a picturesque feature of the forest, and no tree of its race is more desirable for the decoration of pleasure-grounds in countries with cold climates.

EXPLANATION OF THE PLATE.

Plate CCCCLI. Betula papyrifera.

1. A flowering branch, natural size.
2. Scale of the staminate ament, rear view, enlarged.
3. A staminate flower with its scale, side view, enlarged.
4. A stamen, enlarged.
5. Pistillate flowers with their scale, front view, enlarged.
6. A fruiting branch, natural size.
7. Scale of the fruiting ament, enlarged.
8. A nut, enlarged.
9. Vertical section of a nut, enlarged.
10. A seed, enlarged.
11. A winter branch with staminate aments, natural size.
12. A fertile winter-bud, enlarged.
13. A sterile winter-bud, enlarged.
14. A young branchlet with unfolding leaves, stipules, and a pistillate ament, natural size.



C.E. Faxon del. Rapine sc.

BETULA PAPYRIFERA, Marsh.

A. Riocreux direx.t Imp. J. Taneur, Paris.

BETULA NIGRA.

Red Birch. River Birch.

STROBILES cylindrical, oblong, erect. Leaves rhombic-ovate, acute at both ends, lustrous on the upper surface, pale and pubescent on the lower.

Betula nigra, Linnæus, *Spec.* 982 (1753). — Muenchhausen, *Hausv.* v. 113. — Marshall, *Arbust. Am.* 18. — Schoepf, *Mat. Med. Amer.* 134. — Walter, *Fl. Car.* 231. — Wangenheim, *Beschreib. Nordam. Holz.* 92. — Castiglioni, *Viag. negli Stati Uniti*, ii. 207. — Gærtner, *Fruct.* ii. 54, t. 90. — Willdenow, *Berl. Baumz.* 42; *Spec.* iv. pt. i. 464; *Enum.* 981. — Borkhausen, *Handb. Forstbot.* i. 505. — *Nouveau Duhamel*, iii. 203, t. 51. — Persoon, *Syn.* ii. 572. — Desfontaines, *Hist. Arb.* ii. 477. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 408. — Stokes, *Bot. Mat. Med.* iv. 368. — Pursh, *Fl. Am. Sept.* ii. 621. — Nuttall, *Gen.* ii. 218. — Hayne, *Dendr. Fl.* 166. — Poiret, *Lam. Dict. Ill.* iii. 350, t. 760, f. 2. — Elliott, *Sk.* ii. 616. — Jaume St. Hilaire, *Traité des Arbres Forestiers*, t. 8. — Watson, *Dendr. Brit.* ii. 153, t. 153. — Sprengel, *Syst.* iii. 854. — Torrey, *Fl. N. Y.* ii. 201. — Emerson, *Trees Mass.* 208; ed. 2, i. 237. — Darlington, *Fl. Cestr.* ed. 3, 275. — Dietrich, *Syn.* v. 303. — Chapman, *Fl.* 428. — Curtis *Rep. Geolog. Surv. N. Car.* 1860, iii. 73. — Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 118, t. 12, f. 1–12, t. 13, f. 30–37 (*Monographia Betulacearum*); *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 412 (*Gattungen Betula und Alnus*); *De Candolle Prodr.* xvi. pt. ii. 175. — K. Koch, *Dendr.* ii. pt. i. 644. — Lauche, *Deutsche Dendr.* ed. 2, 273. — Burbank, *Proc. Bost. Soc. Nat. Hist.* 1882, 85. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 161. — Watson & Coulter, *Gray's Man.* ed. 6, 472. — Dippel, *Handb. Laubholzk.* ii. 186. — Koehne, *Deutsche Dendr.* 107. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 413 (*Man. Pl. W. Texas*).

Betula lanulosa, Michaux, *Fl. Bor.-Am.* ii. 181 (1803). — *Nouveau Duhamel*, iii. 206.

Betula rubra, Michaux f. *Hist. Arb. Am.* ii. 142, t. 3 (1812). — Loddiges, *Bot. Cab.* xiii. t. 1248. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 185 (*Revisio Betulacearum*); *Hist. Vég.* xi. 230. — Endlicher, *Gen.* Suppl. iv. pt. ii. 19.

A tree, eighty or ninety feet in height, with a trunk which often divides, fifteen or twenty feet above the ground, into two or three slightly diverging limbs and is sometimes five feet in diameter, and stout spreading comparatively slender pendulous branches forming, while the tree is young, an open pyramidal head, and in old age a narrow round-topped very irregular and picturesque crown; or often the Red Birch sends up from the ground a clump of several small spreading stems forming a low bushy tree. The bark at the base of old trunks is from three quarters of an inch to an inch in thickness, dark red-brown, deeply furrowed, and broken on the surface into thick closely appressed scales; higher on the trunk, on the large branches, and on young stems, it is much thinner, lustrous, light reddish brown or silvery gray and marked with narrow slightly darker longitudinal lenticels, and separates freely into thin papery plates which remain for several years on the stem and branches, curling back and showing the light pink-brown tints of the freshly exposed inner layers of bark. The branchlets are slender and at first are coated with thick pale or slightly rufous tomentum which gradually disappears before the winter, when they become dark red and lustrous, and are marked with minute pale lenticels; in their second season they are dull red-brown and then grow slightly darker during several years, until the bark begins to separate into the thin flakes which cover the older branches. The buds are ovate, acute, and about a quarter of an inch long; in summer, when they are fully grown, they are clothed with thick pale tomentum, and in the winter are glabrous or slightly puberulous, lustrous, and bright chestnut-brown; the inner scales, which are sometimes three quarters of an inch in length after the opening of the bud, are strap-shaped, light brown tinged with red, and coated with pale hairs. The leaves are rhombic-ovate, acute, abruptly or gradually narrowed and wedge-shaped at the base, and doubly serrate with small callous-tipped triangular teeth, or on vigorous young branches often more or less laciniately cut into acute doubly serrate lobes; when they unfold they are light yellow-green and

pilose above, and are coated below, especially on the midribs and on the petioles, with thick white tomentum, and at maturity they are thin and very tough in texture, from an inch and a half to three inches long, from one to two inches broad, deep green and very lustrous on the upper surface, and pale yellow-green on the lower surface, which is pubescent until after the leaves are fully grown, and then gradually becomes glabrous, with the exception of a persistent clothing of pale hairs along the stout midribs and remote primary veins; they are borne on slender slightly flattened tomentose petioles about half an inch long, and in the autumn turn a dull yellow before falling. The stipules are ovate, rounded or acute at the apex, pale green and covered on the lower surface with white hairs, and become reflexed and usually fall soon after the expansion of the leaf. During the winter the clustered staminate catkins are about seven eighths of an inch in length and one sixteenth of an inch in thickness, and are covered with ovate rounded dull chestnut-brown lustrous scales, and when they are fully grown and the flowers open in very early spring they are from two to three inches long and an eighth of an inch thick, with scales which are light yellow below the middle and bright chestnut-brown toward the apex. The pistillate catkins are about a third of an inch in length, with bright green ovate scales pubescent on the back and rounded or acute at the apex, which is ciliate with long white hairs, and are borne on slender tomentose peduncles bibracteolate with lanceolate acute hairy caducous bractlets, and about a quarter of an inch long. The strobiles ripen in May at the south and in the middle of June at the north; they are cylindrical, from an inch to an inch and a half long and half an inch thick, and stand erect or nearly so on stout tomentose peduncles half an inch in length and conspicuously marked with the scars of the fallen bractlets; the scales are oblong-obovate and three-lobed by wide sinuses nearly to the middle, the lateral lobes being erect and slightly spreading and rather shorter than the central lobe; they are nearly a quarter of an inch in length, three or four times as long as they are broad, and pubescent on the back. The nut is broadly ovate or oval, about an eighth of an inch long, pubescent or puberulous at the apex, and furnished with a thin puberulous wing ciliate on the margin and as broad or a little broader than the seed.

Betula nigra inhabits the banks of streams, ponds, and swamps, growing in deep rich soil which is often inundated for several weeks at a time. In Massachusetts it occurs on the banks of the Nashua River near Fitchburg,[1] and is common on those of the Merrimac River in the neighborhood of Lawrence and Lowell, and on the Spicket and Shawsheen Rivers near their junction with the Merrimac.[2] It reappears on the banks of Wading River on Long Island, New York, and then extends southward to western Florida through the regions east of the Alleghany Mountains with the exception of those in the immediate neighborhood of the coast; through the Gulf States it ranges to the valley of the Trinity River in Texas, and through the Mississippi Valley to the Indian Territory, eastern Kansas,[3] the bottom-lands of the Missouri River in eastern Nebraska,[4] central Minnesota,[5] and southern Wisconsin and Ohio.

The wood of *Betula nigra* is light, rather hard, strong, and close-grained; it is light brown, with pale sapwood composed of forty or fifty layers of annual growth, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.5762, a cubic foot weighing 35.91 pounds. It is used in the manufacture of furniture, wooden-ware, wooden shoes, and ox-yokes, and in turnery.

First described by Plukenet in 1696,[6] the River Birch was introduced into English plantations by Peter Collinson[7] in 1736.[8] It is one of the most interesting trees of its genus. It is the only semi-

[1] In 1891 Mr. G. E. Stone of Worcester, Massachusetts, established the fact of the existence of *Betula nigra* on the banks of the Nashua River.

[2] Robinson, *Bull. Essex Inst.* xi. 32.

[3] Mason, *Eighth Bienn. Rep. State Board Agric. Kansas*, 271.

[4] Bessey, *Rep. Nebraska State Board Agric.* 1894, 111.

[5] Macmillan, *Metaspermæ of the Minnesota Valley*, 189.

[6] *Betula nigra Virginiana*, *Alm. Bot.* 67 (excl. syn.). — Ray, *Hist. Pl.* iii. *Dendr.* 12.

Betula foliis ovatis oblongis acuminatis serratis, Clayton, *Fl. Virgin.* 188.

Betula nigra foliis rhombeis ovatis acuminatis duplicato serratis, Romans, *Nat. Hist. Florida*, 28.

[7] See i. 8.

[8] Aiton, *Hort. Kew.* iii. 336. — Loudon, *Arb. Brit.* iii. 1710, f. 1562, 1563, t.

aquatic Birch, and its seeds, like those of several other trees which are partly inundated during a portion of the year, ripen in early summer when the water of streams is usually at its lowest level, and, falling on the damp rich soil of their exposed banks, germinate at once and produce plants which obtain a firm foothold and grow to be several inches high before the autumn. Other Birches inhabit cold northern countries or high mountains in warmer regions, but the River Birch flourishes and attains its largest size in the damp semitropical lowlands of Florida, Louisiana, and eastern Texas.

The River Birch is a beautiful tree with its massive dark trunk, its graceful branches roughened by the curling flakes of its bright bark, with its lustrous leaves and delicate winter spray;[1] and to its presence upon their banks, dipping the ends of its slender flexible branches into placid or bounding waters, the charm of many southern rivers is often largely due. When cultivated the River Birch grows rapidly in good soil and does not need the vicinity of water to insure its development into a large and graceful tree; but, although it is admirably suited to decorate the parks of cold and temperate countries, it has rarely been planted except in a few of the old pleasure-grounds of central and northern Germany.

[1] Sargent, *Garden and Forest*, ii. 591, f. 149. — Rothrock, *Forest Leaves*, iv. 185, f.

EXPLANATION OF THE PLATE.

Plate CCCCLII. Betula nigra.

1. A flowering branch, natural size.
2. Scale of a staminate ament, rear view, enlarged.
3. Pistillate flowers with their scale, front view, enlarged.
4. Scale of a pistillate ament, rear view, enlarged.
5. A fruiting branch, natural size.
6. Scale of a strobile, enlarged.
7. A nut, enlarged.
8. Vertical section of a nut, enlarged.
9. A winter branch with staminate catkins, natural size.
10. A sterile winter-bud, enlarged.

C.E. Faxon del. *Lebrun sc.*

BETULA NIGRA, L.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

BETULA OCCIDENTALIS.

Black Birch.

STROBILES oblong, long-stalked, erect or hanging. Leaves broadly ovate, wedge-shaped or rounded at the base.

Betula occidentalis, Hooker, *Fl. Bor.-Am.* ii. 155 (1839). — Spach, *Ann. Sci. Nat.* sér. 2, xv. 197 (*Revisio Betulacearum*). — Nuttall, *Sylva*, i. 22, t. 7. — Endlicher, *Gen.* Suppl. iv. pt. ii. 20. — Torrey, *Frémont's Rep.* 97; *Bot. Wilkes Explor. Exped.* 466. — Dietrich, *Syn.* v. 304. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 89. — Cooper, *Am. Nat.* iii. 408. — Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 131, t. 15, f. 35 (*Monographia Betulacearum*). — Porter, *Hayden's Rep.* 1871, 493. — Watson, *King's Rep.* v. 323, t. 35; *Pl. Wheeler*, 17. — Rothrock, *Wheeler's Rep.* vi. 239. — Brewer & Watson, *Bot. Cal.* ii. 79. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 160. — Dippel, *Handb. Laubholzk.* ii. 176. — Koehne, *Deutsche Dendr.* 110.

Betula alba, subsp. 5. **occidentalis**, *a* **typica**, Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 400, t. 7, f. 1–5 (*Gattungen Betula und Alnus*) (1865); *De Candolle Prodr.* xvi. pt. ii. 165.

A tree, occasionally from thirty to forty feet in height, with a trunk from twelve to eighteen inches in diameter, and slender spreading graceful pendulous branches which form an open feathery head; or more commonly with many thin spreading stems springing up from the ground in open clusters fifteen or twenty feet high or often much lower, and frequently crowded into nearly impenetrable thickets. The bark of the trunk is about a quarter of an inch thick, dark bronze-color, very lustrous, and marked with pale brown longitudinal lenticels, which on old trunks are often from six to eight inches long and a quarter of an inch wide. The branchlets are slender at first, light green and much roughened with large lustrous resinous glands which do not disappear until their second season; they soon turn a dark orange-color, and during their first winter are rather bright red-brown, becoming in the following summer dark reddish brown or bronze-color and very lustrous, and are marked with conspicuous pale lenticels which gradually lengthen as the branches increase in size. The buds are ovate or slightly obovate, acute, about a quarter of an inch long, and covered with resin; they are bright green and lustrous at midsummer, when they are fully grown, and during the winter are light chestnut-brown. The leaves are broadly ovate, acute at the apex, sharply and often doubly serrate with spreading or incurved stout glandular mucronate teeth, and sometimes slightly laciniately lobed except at the rounded abruptly wedge-shaped truncate or subcordate and often somewhat unequal base; when they unfold they are pale green, pilose on the lower surface with a few long pale hairs, and covered with conspicuous resinous glands, and at maturity they are thin and firm in texture, above dark dull green and sometimes marked until late in the summer with the remnants of the glands, below pale yellow-green, rather lustrous, and covered with minute glandular dots, from one to two inches long and from three quarters of an inch to an inch wide, with slender pale midribs and remote primary veins coated with minute dark glands, and rather conspicuous reticulate veinlets; they are borne on stout puberulous light yellow and glandular dotted petioles flattened on the upper side, often flushed with red, and from one third to nearly one half of an inch long, and turn a dull yellow in the autumn before falling. The stipules are broadly ovate, acute or rounded at the apex, slightly ciliate on the margins, and bright green at first but soon becoming pale and scarious. During the winter the clustered staminate aments are from one half to three quarters of an inch long and about a sixteenth of an inch thick, with ovate acute light chestnut-brown lustrous scales pale and slightly ciliate on the margins, and when they are fully grown and the flowers open in spring they are from two to two and a half inches long and about an eighth of an inch thick, with apiculate scales dark red-brown above the

middle and yellow below. The pistillate aments are short-stalked and about three quarters of an inch in length, with ovate acute green scales and bright red styles. The strobiles ripen in August and are cylindrical, rather obtuse, from an inch to an inch and a quarter long, and erect or pendulous on slender glandular petioles from one quarter to nearly three quarters of an inch in length; the scales are puberulous or sometimes nearly glabrous, ovate, longer than they are broad, and wedge-shaped below, with stout nearly erect lateral lobes. The nut is ovate or obovate and puberulous at the apex, with a wing much broader than the seed.

Betula occidentalis, which grows in moist soil near the banks of streams in mountain cañons, is widely and generally distributed, although nowhere very common, throughout the northwestern and central regions of the continent. From the basin of the upper Fraser and Pease Rivers in British Columbia it ranges southward to the valleys of Mt. Shasta and the cañons on the eastern slopes of the northern Sierra Nevada in California, eastward through Albertina along the valley of the Saskatchewan to the neighborhood of Edmonton,[1] and southward along the Rocky Mountains and other interior ranges to Nevada, Utah, and northern New Mexico, spreading eastward to the Black Hills of Dakota,[2] northwestern Nebraska,[3] and the eastern base of the Rocky Mountains in Colorado.

The wood of *Betula occidentalis* is soft and strong, although brittle, and close-grained; it is light brown, with thick lighter colored sapwood, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.6030, a cubic foot weighing 37.58 pounds. It is sometimes used for fuel and for fencing.

Betula occidentalis, which enlivens sombre cañons and elevated valleys with its masses of graceful feathery stems, its beautiful lustrous bark and the cheerful green of its foliage, was discovered by Lewis and Clark on August 5, 1805, on the banks of the Jefferson River at the eastern base of the Rocky Mountains;[4] and afterwards was found by Dr. John Scouler[5] near the coast of British Columbia.

In 1874 *Betula occidentalis* was introduced into the Arnold Arboretum, where, as a small shrub, it flowers and ripens its fruit.

[1] G. M. Dawson, *Can. Nat.* n. ser. ix. 331. — Macoun, *Cat. Can. Pl.* 437.

[2] Williams, *Bull.* No. 43, *South Dakota Agric. Coll.* 108.

[3] Bessey, *Rep. Nebraska State Board Agric.* 1894, 111.

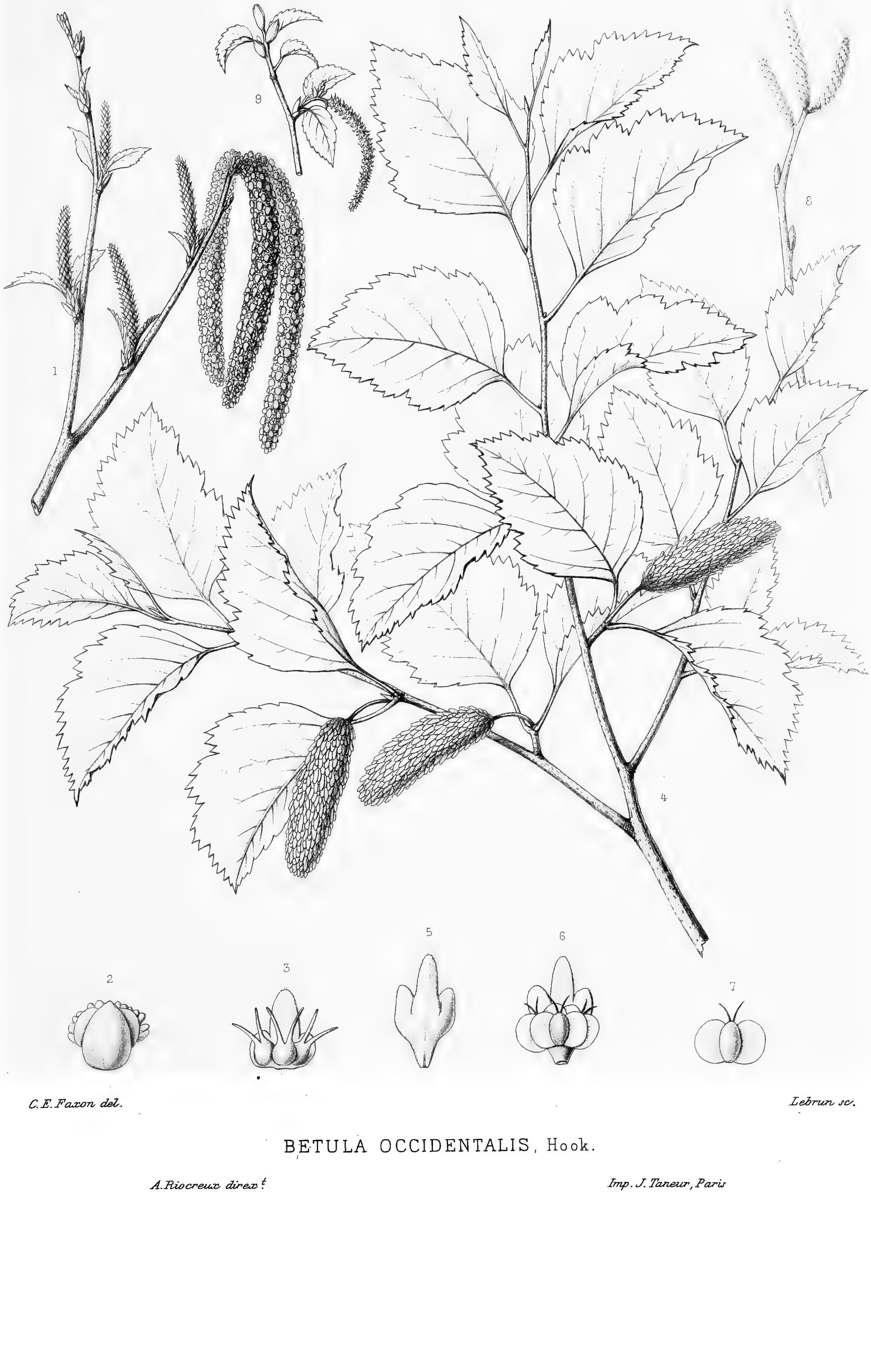
[4] *History of the Expedition under the Command of Lewis and Clark*, ed. Coues, ii. 457.

[5] John Scouler (1804–71), a native of Glasgow, was graduated from the Medical School of his native city, and became a zoölogist and geologist. In 1824 he was attached to the Hudson's Bay Company's ship William and Ann as surgeon and naturalist, and visited, in company with David Douglas, Madeira, Brazil, and the northwest coast of North America, where he remained from 1825 to 1827 and made collections of plants which he sent to his teacher of botany, Sir William J. Hooker, who named in his honor *Scouleria*, a genus of Mosses discovered by him in North America. On his return from America Dr. Scouler visited India, and afterward settling in Glasgow was appointed professor of natural history in the Andersonian University. From 1833 to 1854 Dr. Scouler was professor of zoölogy and botany in Trinity College, Dublin. (See *Trans. Geolog. Soc. Glasgow*, iv. 194.)

EXPLANATION OF THE PLATE.

PLATE CCCCLIII. BETULA OCCIDENTALIS.

1. A flowering branch, natural size.
2. Scale of a staminate ament, rear view, enlarged.
3. Pistillate flowers with their scale, front view, enlarged.
4. A fruiting branch, natural size.
5. Scale of a strobile, rear view, enlarged.
6. Scale of a strobile, front view, with nut, enlarged.
7. A nut, enlarged.
8. A winter branch with staminate aments, natural size.
9. A young branchlet with unfolding leaves and stipules, natural size.



C.E. Faxon del. Lebrun sc.

BETULA OCCIDENTALIS, Hook.

A. Riocreux direx.t Imp. J. Taneur, Paris

ALNUS.

FLOWERS unisexual, monœcious, apetalous, the staminate in long pendulous aments; calyx usually 4-parted; stamens usually 4; the pistillate in erect cylindrical aments; ovary naked, 2-celled; ovule solitary in each cell, suspended. Fruit a winged or wingless nut covered by the woody persistent scale of a strobile. Leaves alternate, generally serrate, stipulate, deciduous.

Alnus, Linnæus, *Gen.* 285 (1737). — Endlicher, *Gen.* 272. — Meisner, *Gen.* 351. — Baillon, *Hist. Pl.* vi. 254. — Bentham & Hooker, *Gen.* iii. 404. — Prantl, *Engler & Prantl Pflanzenfam.* iii. pt. i. 45.

Betula, Linnæus, *Gen.* ed. 6, 485 (in part) (1764). — Adanson, *Fam. Pl.* ii. 375 (in part). — A. L. de Jussieu, *Gen.* 409 (in part).

Clethropsis, Spach, *Ann. Sci. Nat.* sér. 2, xv. 201 (*Revisio Betulacearum*) (1841).

Semidopsis, Zumaglini, *Fl. Pedem.* i. 249 (1849).

Alnobetula, Schur, *Verh. Siebenb. Ver. Naturw.* iv. 68 (*Enum. Pl. Trans.*) (1858).

Trees or shrubs, with watery juice, astringent scaly bark, soft straight-grained wood, terete branchlets marked with pale lenticels, often stoloniferous roots, and fibrous rootlets. Leaf-buds without scales, stipitate, elongated, slightly three-angled, oblong and acute, or clavate and rounded at the apex, formed in summer, nearly inclosed by the united stipules of the first leaf becoming in winter thick, resinous, dark red, and glabrous or scurfy-pubescent.[1] Leaves in the bud inclosed in their stipules, the lowest next the branch, open and convex, but becoming conduplicate or sometimes even revolute in expansion, plicately folded along the primary veins, alternate, penniveined, serrate, or rarely entire, petiolate, deciduous, falling without change of color, and leaving small semioval elevated leaf-scars displaying the ends of three equidistant fibro-vascular bundles. Stipules, except those of the first leaf, ovate, acute, scarious, deciduous. Flowers opening in the early spring before or with the unfolding of the leaves, or rarely in the autumn, monœcious, sessile, in from one to six-flowered cymes in the axils of the peltate short-stalked scales of pedunculate aments formed in summer or autumn, the peduncles in the axils of the last leaves of the year or in those of minute leafy bracts. Staminate aments elongated, pendulous, panicled, or rarely solitary, in the axils of the last leaves or of leafy bracts, naked and erect during the winter; scales usually three-flowered, rarely one-flowered, the flowers subtended by from three to five minute bractlets adnate to the base of the scale. Calyx usually four or irregularly from ten to twelve-parted. Stamens as many as the number of the divisions of the calyx or rarely half as many, inserted on its base opposite its divisions; filaments short or rarely elongated, undivided; anthers erect, attached on the back, introrse, two-celled, the cells parallel, contiguous, opening longitudinally. Pistillate aments ovoid or oblong, erect, pedunculate, produced in summer in the axils of the leaves of a branch developed from the axil of one of the upper leaves of the year, below the staminate inflorescence, and inclosed at first by the stipules of its first leaf, emerging in the autumn and naked during the winter or remaining covered until early spring, or rarely solitary in the axil of an upper leaf; scales fleshy, two-flowered, the flowers subtended by from two to four minute bractlets adnate to the scale, becoming at maturity thick and woody, obovate, from three to five-lobed or truncate and thickened at the apex, and forming an ovoid or subglobose strobile persistent on the branch after the opening of its closely imbricated scales and the escape of the nuts. Nut minute, bright chestnut-brown, compressed, ovate, orbicular, or obovate, pointed and crowned at the apex with the remnants of the styles, truncate, and marked at the base with a pale umbilicus, wingless, or

[1] Henry, *Nov. Act. Acad. Cæs. Leop.* xviii. 528, t. 39.

furnished with a narrow wing-like membranaceous border; pericarp of two coats, the outer thin and membranaceous, the inner thicker and crustaceous. Seed solitary by abortion, filling the cavity of the nut, suspended, exalbuminous; testa membranaceous, light brown; cotyledons fleshy, flat, much longer than the short superior radicle turned toward the minute apical hilum.[1]

An inhabitant of swamps and river-bottoms and high mountain slopes, and often, especially in northern Europe and Asia, a conspicuous feature of vegetation, Alnus is widely and generally distributed through the boreal and temperate regions of the northern hemisphere, ranging at high elevations southward in the New World through Central America to Colombia, Peru, and Bolivia,[2] and to upper Assam in the Old World.[3] Fifteen species and many varieties are now distinguished.[4] Of the North American species five attain the size and habit of trees, and three, *Alnus Alnobetula*,[5] *Alnus incana*,[6]

[1] The species of Alnus may be grouped in the following sections:

ALNASTER (Endlicher, *Gen.* Suppl. iv. pt. ii. 20. — Prantl, *Engler & Prantl Pflanzenfam.* iii. pt. i. 45 [subgen. *Alnobetula*, K. Koch, *Dendr.* ii. pt. i. 625]). Flowers in three-flowered clusters appearing in spring with the leaves. Staminate aments solitary or in pairs, naked during the winter; pistillate aments pedunculate, in terminal panicles on short two or three-leaved branchlets, covered during the winter; calyx of the staminate flower regularly four-lobed. Nut surrounded by a broad thin wing. Inhabitants of eastern North America, Europe, northern Asia, and Japan.

CLETHROPSIS (Endlicher, *l. c.* — Prantl, *l. c.*). Flowers appearing in spring with the unfolding of the leaves, or in autumn. Staminate aments elongated, pedunculate, the pistillate racemose or solitary; calyx of the staminate flower from ten to twelve-parted, the divisions scale-like, unequal. Nut surrounded by a narrow wing. Inhabitants of the temperate Himalayas.

ALNUS (Endlicher, *l. c.* [secs. Phyllothyrsus and Gymnothyrsus]. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 204 [*Revisio Betulacearum*]. — Regel, *De Candolle Prodr.* xvi. pt. ii. 183, 184 [sec. Gymnothyrsus.] — Prantl, *l. c.* 46). Flowers appearing in the spring before the unfolding of the leaves from paniculate or racemose aments formed during the summer, and naked, or the pistillate rarely covered during the winter, or (*Alnus maritima*) appearing in autumn in aments of the season, the pistillate usually solitary; calyx of the staminate flower regularly four-parted; stamens four or rarely two or three. Nut wingless or surrounded by a narrow coriaceous border. Inhabitants of North and South America, Europe, northern Africa, western and northern Asia.

[2] Humboldt, Bonpland & Kunth, *Nov. Gen. et Spec.* ii. 20. — Kunth, *Syn. Pl. Æquin.* i. 363. — Mirbel, *Mém. Mus.* xiv. 463. — Hemsley, *Bot. Biol. Am. Cent.* iii. 165.

[3] Hooker f. *Fl. Brit. Ind.* v. 600.

[4] Spach, *l. c.* 200. — Endlicher, *l. c.* 20. — Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 131 (*Monographia Betulacearum*); *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 419 (*Gattungen Betula und Alnus*); *De Candolle Prodr. l. c.* 180.

Several plants thought to be intermediate in character between species of Alnus have been noticed; they are believed by some European botanists to be natural hybrids, while others consider them varieties. The best known of these plants is *Alnus pubescens* (Tausch, *Flora*, xvii. pt. ii. 520 [1834]. — Regel, *De Candolle Prodr. l. c.* 187), a supposed hybrid between *Alnus glutinosa* and *Alnus incana*, known in several localities from Lapland to the Caucasus. (See, also, for hybrids of Alnus, K. Koch, *l. c.* 637. — Dippel, *Handb. Laubholzk.* ii. 162. — Koehne, *Deutsche Dendr.* 114, 115.)

[5] K. Koch, *l. c.* 625 (1872). — Otto Kuntze, *Rev. Gen. Pl.* ii. 639.

Betula Alnobetula, Ehrhart, *Beitr.* ii. 72 (1788).

Betula viridis, Villars, *Hist. Pl. Dauph.* iii. pt. ii. 789 (1789).

Betula ovata, Schrank, *Baier. Fl.* i. 419 (1789).

Betula crispa, Aiton, *Hort. Kew.* iii. 339 (1789). — Michaux, *Fl. Bor.-Am.* ii. 181.

Alnus alpina, Borkhausen, *Handb. Forstbot.* i. 477 (1800).

Alnus viridis, De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 304 (1805). — Chamisso, *Linnæa*, vi. 538. — Hooker, *Fl. Bor.-Am.* ii. 157. — Torrey, *Fl. N. Y.* ii. 203, t. 116. — Reichenbach, *Icon. Fl. German.* xii. 3, t. 628. — Regel, *De Candolle Prodr. l. c.* 181. — Parlatore, *Fl. Ital.* iv. 130. — Franchet, *Nouv. Arch. Mus.* v. 281 (*Pl. David.* i.). — Macoun, *Cat. Can. Pl.* 438. — Watson & Coulter, *Gray's Man.* ed. 6, 473. — Hempel & Wilhelm, *Bäume und Sträucher*, ii. 17, f. 126, t. 14.

Alnus undulata, Willdenow, *Spec.* iv. pt. i. 336 (1805).

Alnus crispa, Pursh, *Fl. Am. Sept.* ii. 623 (1814). — Gray, *Am. Jour. Sci.* xlii. 42. — Tuckerman, *Am. Jour. Sci.* xlv. 33.

Alnus ovata, Guimpel, Willdenow & Hayne, *Abbild. Holz.* ii. 199, t. 147 (1820). — Watson, *Dendr. Brit.* ii. 96, t. 96; *Loddiges Bot. Cab.* xii. t. 141. — Hartig, *Forst. Culturpfl. Deutschl.* 372, t. 26.

Alnaster viridis, Spach, *l. c.* 201 (1841).

Alnus incana, Hooker & Arnott, *Bot. Voy. Beechey*, 117, 129 (not Willdenow) (1832).

Alnus fruticosa, Ruprecht, *Fl. Samoj. Cisur.* 53 (1845).

Alnaster fruticosus, Ledebour, *Fl. Ross.* iii. 655 (1849).

Alnus Brembana, Rota, *Prosp. Prov. Bergamasco*, 79 (1855).

Alnus glutinosa, γ *Sibirica*, Miquel, *Ann. Mus. Lugd. Bat.* iii. 194 (*Prol. Fl. Jap.*) (1867).

Alnus Alnobetula, which is a shrub two or three feet high, or sometimes on the mountains of northern Japan attains the height of fifteen or twenty feet and assumes the habit of a tree (*Alnus viridis*, β *Sibirica*, Regel, *Nouv. Mém. Soc. Nat. Mosc. l. c.* 137. — Sargent, *Forest Fl. Japan*, 63), inhabits the Arctic Circle and high mountain slopes in the northern hemisphere. In America it is a common plant in all the north from Newfoundland and Labrador to Alaska, and in the United States grows on the mountains of New England and New York, along the coast of Maine, in northern Minnesota, and on the high peaks of the southern Alleghany Mountains in Carolina and Tennessee.

[6] Willdenow, *Spec. l. c.* 335 (1805); *Enum.* 965; *Berl. Baumz.* ed. 2, 20. — De Candolle, *l. c.* — Hornemann, *Fl. Dan.* xiii. t. 2301. — Emerson, *Trees Mass.* 220; ed. 2, i. 251, t. — Hooker f. *l. c.* 157. — Spach, *l. c.* 206. — Nuttall, *Sylva*, i. 30. — Tuckerman, *l. c.* 32. — Torrey, *l. c.* 202. — Ledebour, *l. c.* 656. — Reichenbach, *l. c.* 4, t. 629, 630. — Hartig, *l. c.* 368, t. 24. — Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 258 (*Prim. Fl. Amur.*). — Parlatore, *Fl. Ital.* iv. 128. — K. Koch, *l. c.* 636. — Franchet & Sava-

and *Alnus rugosa*,[1] are shrubs. During the tertiary period species of Alnus were probably much more numerous, especially in Europe, where palæontologists have described about thirty from the eocene and miocene formations.[2]

Alnus produces soft straight-grained wood, very durable in water, and astringent bark and strobiles, which are used in tanning leather[3] and in medicine.[4] The most valuable species are *Alnus glutinosa*[5]

tier, *Enum. Pl. Jap.* i. 458. — Boissier, *Fl. Orient.* iv. 1180. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 164. — Watson & Coulter, *Gray's Man.* ed. 6, 473. — Hempel & Wilhelm, *Bäume und Sträucher*, ii. 15, f. 124, 125, t. 13.

Betula Alnus, β *incana*, Linnæus, *Spec.* 983 (1753). — Du Roi, *Harbk. Baumz.* i. 109.

Betula incana, Linnæus f. *Suppl.* 417 (1781). — Roth, *Tent. Fl. German.* ii. 477. — Willdenow, *Berl. Baumz.* 45.

Betula-Alnus glauca, Marshall, *Arbust. Am.* 20 (1785).

Alnus lanuginosa, Gilibert, *Exercit. Phyt.* ii. 402 (1792).

Alnus glauca, Michaux f. *Hist. Arb. Am.* iii. 322, t. 4, f. 2 (1813). — Bigelow, *Fl. Boston.* ed. 3, 367.

Alnus incana, var. *glauca*, Gray, *Man.* 423 (1848).

In North America, where it is the common Alder of swamps and river-banks in the northeastern parts of the continent, forming dense shrubby thickets rarely more than ten or twelve feet high, *Alnus incana* is distributed from Newfoundland to the eastern base of the Rocky Mountains, ranging southward in the United States to Staten Island, New York, Wisconsin, and eastern Nebraska.

In many forms it is spread all over northern and central Europe from northern Scandinavia and Russia to France, northern Italy, and the Caucasus, growing in the extreme north on sandy plains near streams, but in the south usually on mountain slopes, and sometimes attaining a height of seventy feet; it is the common Alder of Siberia and northeastern Asia, and is very abundant in northern Japan, becoming, on the island of Yezo, a stately tree fifty or sixty feet in height, with a trunk often two or three feet in diameter. Here it flourishes in moist rich soil on low slopes rising from streams bordered with the largest of the Japanese Alders, *Alnus Japonica*, Siebold & Zuccarini, which is a pyramidal tree eighty or ninety feet tall, and clothed to the ground with large dark green lustrous leaves (Sargent, *Forest Fl. Japan*, 63). In Japan the wood of *Alnus incana* is used in turnery, and is manufactured into boxes and other small articles.

[1] K. Koch, *Dendr.* ii. pt. i. 635 (1872).

Betula Alnus (*rugosa*), Du Roi, *l. c.* 112 (1771).

Betula-Alnus rubra, Marshall, *l. c.* 20 (1785).

Betula serrulata, Aiton, *Hort. Kew.* iii. 338 (1789). — Willdenow, *l. c.* — Abbot & Smith, *Insects of Georgia*, ii. 183, t. 92. — Michaux, *Fl. Bor.-Am.* ii. 181.

Alnus serrulata, Willdenow, *Spec.* iv. pt. i. 336 (1805); *Enum.* 965; *Berl. Baumz.* ed. 2, 21. — *Nouveau Duhamel*, ii. 216. — Persoon, *Syn.* ii. 550. — Desfontaines, *Hist. Arb.* ii. 488. — Aiton, *Hort. Kew.* ed. 2, v. 259. — Michaux f. *Hist. Arb. Am.* iii. 320, t. 4, f. 1. — Pursh, *Fl. Am. Sept.* ii. 623. — Nuttall, *Gen.* ii. 206. — Elliott, *Sk.* ii. 567. — Torrey, *Fl. N. Y.* ii. 202, t. 115. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 205 (*Revisio Betulacearum*). — Emerson, *Trees Mass.* 218; ed. 2, i. 248, t. — Chapman, *Fl.* 429. — Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 432 (*Gattungen Betula und Alnus*) (excl. γ *oblongifolia*); *De Candolle Prodr.* xvi. pt. ii. 188 (excl. γ *oblongifolia*). — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 108. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 164. — Watson & Coulter, *l. c.*

Alnus incana, β, Hooker, *Fl. Bor.-Am.* iii. 157 (1839).

Alnus rubra, Tuckerman, *Am. Jour. Sci.* xlv. 32 (not Bongard) (1843).

Alnus glutinosa, δ *serrulata*, Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 164, t. 11, f. 6–10 (*Monographia Betulacearum*) (1861).

Alnus glutinosa, var. *rugosa*, Regel, *l. c.* 165, t. 11, f. 8–10 (1861).

Alnus rugosa is distributed from Essex County, Massachusetts, westward to southeastern Minnesota and southward to northern Florida and the valley of the Trinity River in Texas. Less common in the north than in the southeastern states, where it is very abundant and the only species of Alder, *Alnus rugosa* sometimes grows to the height of twenty-five or thirty feet, sending up from the ground numerous slender stems, and forming a broad round-topped shrub with cuneate-obovate leaves rounded or acute at the apex, green on both surfaces, and smooth or puberulous on the lower, and ovate strobiles.

[2] Lesquereux, *Rep. U. S. Geolog. Surv.* vii. 139 (*Contrib. Fossil Fl. W. Territories*, iii.). — Saporta, *Origine Paléontologique des Arbres*, 142. — Zittel, *Handb. Palæontolog.* ii. 411.

[3] Neubrand, *Die Gerbrinde*, 220. — Dreykorn & Reichardt, *Dingler Polytech. Jour.* cxcv. 157 (*Ueber den farbigen Gerbstoff des Erlenholzes*); *Archiv. der Pharm.* ser. 2, cxlii. 215. — Eitner, *Erlenrinde als Gerbmaterial*, *Der Gerber*, iv. 84. — Höhnel, *Die Gerberinden*, 56.

[4] Alder bark is an alterative and astringent, and in the United States is sometimes used in decoctions, in domestic practice, to purify the blood, in diarrhœa, hæmaturia, and intermittent fevers, and as a gargle (Johnson, *Man. Med. Bot. N. Am.* 253. — *U. S. Dispens.* ed. 16, 1705).

[5] Gaertner, *Fruct.* ii. 54, t. 90 (1791). — Willdenow, *Spec. l. c.* 334. — Brotero, *Fl. Lusitan.* i. 210. — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 303. — Hornemann, *Fl. Dan.* xiii. t. 2302. — Guimpel, Willdenow & Hayne, *Abbild. Holz.* ii. 180, t. 135. — Hayne, *Arzn.* xiii. 48, t. 48. — Ledebour, *Fl. Ross.* iii. 657. — Reichenbach, *Icon. Fl. German.* xii. 4, t. 631. — Hartig, *Forst. Culturpfl. Deutschl.* 338, t. 23. — Regel, *Nouv. Mém. Soc. Nat. Mosc. l. c.* 159; *Bull. Soc. Nat. Mosc. l. c.* 430; *De Candolle Prodr. l. c.* 186. — Parlatore, *Fl. Ital.* iv. 124. — Boissier, *l. c.* 1180. — Hempel & Wilhelm, *l. c.* 11, f. 121–123, t. 12.

Betula Alnus, β *glutinosa*, Linnæus, *Spec.* 983 (1753). — Scopoli, *Fl. Carn.* ed. 2, ii. 233.

Betula glutinosa, Lamarck, *Dict.* i. 454 (1783).

Alnus nigra, Gilibert, *l. c.* 401 (1792).

Alnus communis, *Nouveau Duhamel*, ii. 212, t. 64 (1802).

Alnus glutinosa (*vulgaris*), Persoon, *l. c.* (1807).

Alnus rotundifolia, Stokes, *Bot. Mat. Med.* iv. 369 (1812).

Alnus elliptica, Requien, *Ann. Sci. Nat.* sér. 1, v. 381 (1825).

Alnus barbata, C. A. Meyer, *Verz. Pl. Caucas.* 43 (form with leaves hairy below along the principal veins) (1831).

Alnus denticulata, C. A. Meyer, *l. c.* (form with leaves conspicuously denticulate) (1831).

Alnus Morisiana, Bertoloni, *Fl. Ital.* x. 163 (1854).

Alnus Februaria, Otto Kuntze, *Taschenfl. Leipz.* 283 (1867).

Alnus glutinosa is spread all over Europe, where it flourishes on the borders of streams and swamps in situations too wet even for

of Europe and Asia, the American, European, and north Asian *Alnus incana*, the Himalayan *Alnus Nepalensis*[1] and *Alnus nitida*,[2] and the American *Alnus Oregona*.

In North America Alnus is injured by numerous insects,[3] especially by those which bore into the living wood, but is comparatively free from the attacks of fungal diseases.[4]

the Willow and Poplar, growing sometimes under favorable conditions to the height of fifty or sixty feet, but at high elevations and in the extreme north often reduced to a low shrub ; it also inhabits northern Africa, Anatolia, Armenia, the Caucasian provinces, and Siberia. It has a symmetrical pyramidal or ultimately round-topped head, cuneate-obovate subrotund leaves obtuse or retuse at the apex, green on both surfaces, and glutinous while young, ovate strobiles, and nuts surrounded by a narrow coriaceous wing or wingless.

The wood, which is probably not often distinguished commercially from that of *Alnus incana*, the second arborescent species of central and northern Europe, is soft, straight-grained, and light reddish brown ; soon decaying when exposed to changes of temperature and to alternations of moisture and dryness, it is practically indestructible as long as it is kept under water, and is therefore valuable for wharf and bridge piles, water pipes, and the barrels of pumps. It is also often employed in turnery and for carving, in the manufacture of basins, platters, wooden shoes, and light chairs, light packing-cases, and in cooperage. (See *Industries of Russia*, iii. 338.) The durability of the small branches makes them valuable for lining drains. The wood, however, is most largely used in the production of charcoal for the manufacture of gunpowder, being surpassed for this purpose only by that of some species of Willow and of *Rhamnus Frangula*, Linnæus ; and in Europe it is extensively planted in coppice, and regularly cut for this purpose. The bark and the fruit are used in tanning leather, and from the bark and the foliage a yellow dye is obtained. Linen and woolen cloths are dyed black by boiling them with the flowers, young leaves, and branchlets. The European Alders are used to form hedges on low swampy ground, and are planted to hold the banks of streams with their strong stoloniferous roots. (See Loudon, *Arb. Brit.* iii. 1681.)

Alnus glutinosa has been introduced into the northern United States, where it is perfectly hardy, and while young grows very rapidly ; it suffers seriously, however, from borers working in the trunk and branches, and is usually short-lived. A number of varieties with variously cut or divided, or yellow leaves, or with fastigiate branches, are propagated by nurserymen, and occasionally planted in the gardens of northern Europe (Dippel, *Handb. Laubholzk.* ii. 160).

[1] D. Don, *Prodr. Fl. Nepal.* 58 (1825). — Wallich, *Pl. As. Rar.* ii. 27, t. 131. — Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 141 (*Monographia Betulacearum*) ; *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 421 (*Gattungen Betula und Alnus*) ; *De Candolle Prodr.* xvi. pt. ii. 181. — Kurz, *Forest Fl. Brit. Burm.* ii. 476. — Hooker f. *Fl. Brit. Ind.* v. 600.

Clethropsis Nepalensis, Spach, *Ann. Sci. Nat.* sér. 2, xv. 202 (*Revisio Betulacearum*) (1841).

Alnus Nepalensis, which is a tree fifty or sixty feet tall, with a straight trunk covered with thick compact smooth silvery bark tinged with purple or yellow, and broad rounded leaves, is common in the forests of the temperate Himalayas from southern Cashmere to upper Assam and Yu-nan. The bark is used in India for tanning and dyeing (Brandis, *Forest Fl. Brit. Ind.* 460. — Gamble, *Man. Indian Timbers*, 373).

[2] Endlicher, *Gen.* Suppl. iv. pt. ii. 20 (1847). — Regel, *Nouv. Mém. Soc. Nat. Mosc. l. c.* ; *Bull. Soc. Nat. Mosc. l. c.* ; *De Candolle Prodr. l. c.* — Brandis, *l. c.* t. 57. — Hooker f. *l. c.*

Clethropsis nitida, Spach, *l. c.* (1841). — Decaisne, *Jacquemont Voyage*, 159, t. 159.

Alnus nitida, which is probably the largest of the Alders, sometimes rises to the height of a hundred feet, with a trunk five feet in diameter. It is a common inhabitant of the northwestern Himalayas and the Punjab, at elevations of between three and nine thousand feet above the level of the sea, fringing the banks of streams, and occasionally following them into the plains. The soft tough pale red wood is used in northwestern India in the manufacture of furniture and for the supports of rope bridges ; the twigs are employed in binding loads and in the construction of bridges. The bark is used in tanning leather, in dyeing, and for making red ink (Gamble, *l. c.*).

[3] The insects which affect Alnus in North America have been little studied, although about fifty are now known. Lepidopterous borers like *Fatua denudata*, Harris, and *Hepialus argenteomaculatus*, Harris, appear to do the most damage to the stems of our Alders, the latter particularly affecting parts near the ground. Species of Saperda and other Longicorn beetles also injure the stems.

Among foliage destroyers, a Flea-beetle, *Haltica bimarginata*, Say, is one of the most destructive known, and in some parts of the country the leaves of Alnus are eaten by the small dark-colored larvæ of this insect. *Calligrapha scalaris*, Leconte, also feeds upon the Alder in its larval and beetle stages. Saw-fly larvæ of several species are troublesome, either feeding externally or within the tissues of the leaves. *Fenusa varipes*, Norton, a small black Saw-fly, is sometimes very destructive to the leaves of Alders, the larvæ eating out the parenchyma, and causing them to turn brown and fall before midsummer, the successive broods destroying new leaves as they appear. The larvæ of a few of the larger Lepidoptera feed on the foliage, and Lepidopterous leaf-miners are common ; among these are several species of Lithocolletis and two or three of Gracilaria described as peculiar to Alnus. *Lyonetia alniella*, Chambers, makes large brownish blotch-mines in the leaves. Mites frequently form immense numbers of minute galls on the upper surface of the leaves ; and scale insects and aphids often seriously infest the trees. The so-called Alder Blight, *Schizoneura tessellata*, Fitch, sometimes occurs on the branches in large clusters covered with a white floccose secretion, and seriously affects the vitality of the plant. A species of Lepidopterous larva often lives within and destroys the staminate aments.

[4] Of the many species of fungi found on Alnus in North America, the greater number are common on this genus also in northern Europe. A mildew, *Microsphæra Alni*, Winter, is common on the leaves of *Alnus incana* and *Alnus rugosa*, and *Gnomoniella tubiformis*, Saccardo, is frequently found, although rarely in its mature condition, on leaves of *Alnus Alnobetula*, where it forms discolored spots, from which small black spines, the necks of the perithecia, project. The common Pyrenomycetes *Diatrypella Tocciæana*, De Notaris, and *Melanconis Alni*, Tulasne, frequently infest the branches of *Alnus incana*. Of Hymenomycetous fungi on Alnus may be mentioned, beside the common *Tragia crispa*, Fries, of Europe, a large form, *Tragia Alni*, Peck, peculiar to America, and *Cyphella fulva*, Berkeley & Ravenel, which appears in the form

The species of Alnus can be easily raised from seeds,[1] and the varieties propagated by grafts and layers.

Alnus, the classical name of the Alder, was adopted for this genus by Tournefort[2] and afterward by Linnæus, who subsequently united it with Betula.

of small woolly cups of brown color on the small branches. The aments of *Alnus incana* are attacked by two curious fungi, *Exoascus amentorum*, Ladebeck, and *Erysiphe aggregata*, Farlow; the former causes some of the scales of the catkins to enlarge so that they project an inch or so in the form of more or less twisted club-shaped or ligulate masses; the latter forms a white web over the aments, upon which are borne the small black sporangia.

[1] Cobbett, *Woodlands*, No. 96.

[2] *Inst.* 587, t. 359.

CONSPECTUS OF THE NORTH AMERICAN ARBORESCENT SPECIES.

ALNUS.

Flowers opening in early spring before the unfolding of the leaves from aments formed the previous year.

Stamens, 4.

Leaves ovate or elliptical, rusty-pubescent on the lower surface . . . . . 1. ALNUS OREGONA.

Leaves oblong-ovate, glabrous or puberulous on the lower surface . . . . . 2. ALNUS TENUIFOLIA.

Stamens, usually 2 or 3.

Leaves ovate or oval, pale and slightly puberulous on the lower surface . . . . . 3. ALNUS RHOMBIFOLIA.

Leaves oblong-lanceolate, acute, pale and sometimes puberulous on the lower surface . 4. ALNUS ACUMINATA.

Flowers opening in autumn from aments of the year.

Leaves oblong, ovate or obovate, dark green and lustrous above, pale yellow-green below . . . . . 5. ALNUS MARITIMA.

ALNUS OREGONA.

Alder.

LEAVES ovate or elliptical, rusty-pubescent on the lower surface.

Alnus Oregona, Nuttall, *Sylva*, i. 28, t. 9 (1842). — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 25, 89. — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 28, 68.

Alnus rubra, Bongard, *Mém. Phys. Math. et Nat.* pt. ii. *Acad. Sci. St. Pétersbourg*, ii. 162 (*Vég. Sitcha*) (not *Betula-Alnus rubra*, Marshall) (1833). — Hooker, *Fl. Bor.-Am.* ii. 158. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 205 (*Revisio Betulacearum*). — Endlicher, *Gen.* Suppl. iv. pt. ii. 21. — Lyall, *Jour. Linn. Soc.* vii. 134. — Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 429 (*Gattungen Betula und Alnus*); *De Candolle Prodr.* xvi. pt. ii. 186. — Torrey, *Bot. Wilkes Explor. Exped.* 467. — Brewer & Watson, *Bot. Cal.* ii. 80. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 163. — Parry, *Bull. Cal. Acad.* ii. 351. — Mayr, *Wald. Nordam.* 285, t. 5. — Dippel, *Handb. Laubholzk.* ii. 157, f. 77. — Koehne, *Deutsche Dendr.* 114. — Herder, *Act. Hort. Petrop.* xii. 73 (*Pl. Radd.*). — Greene, *Man. Bot. Bay Region*, 298.

Alnus incana, η **rubra**, Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 157, t. 17, f. 3, 4 (*Monographia Betulacearum*) (1860).

Usually forty or fifty feet high, with a tall straight trunk varying from six inches to two feet in diameter, and a narrow pyramidal head of slender somewhat pendulous branches, *Alnus rubra*, which is one of the largest trees of the genus, often attains the height of eighty feet and forms a trunk three and a half feet through. The bark of the trunk is rarely more than a quarter of an inch thick, and is close, smooth in general appearance but roughened with minute wart-like excrescences, and pale gray or nearly white, the thin outer layer in separating displaying the bright inner bark. The branchlets are slender and marked with minute scattered pale lenticels, and at first are light green and coated with hoary tomentum which does not entirely disappear, especially from their extremities, until the second season; during their first winter they are bright red and lustrous, and then gradually grow lighter and ultimately ashy gray. The winter-buds are about one third of an inch long, dark red and covered with pale scurfy pubescence. The leaves are ovate or elliptical, acute at the apex, abruptly or gradually narrowed and wedge-shaped or rounded at the base, and crenately lobed, the lobes being dentate with minute gland-tipped teeth and slightly revolute on the margins; when they unfold they are coated with pale tomentum, and at maturity are dark green and glabrous, or pilose with scattered white hairs on the upper surface and clothed on the lower with short rusty pubescence, from three to five inches long and from an inch and three quarters to three inches broad, or sometimes on vigorous branches eight or ten inches in length, with broad midribs and primary veins green and impressed on the upper side and orange-colored on the lower, the veins running obliquely to the points of the lobes and connected by conspicuous cross slightly reticulate veinlets; they are borne on orange-colored nearly terete slightly grooved petioles from one half to three quarters of an inch in length and fall gradually very late in the autumn, or at the south during the winter. The stipules are ovate, acute, pale green flushed with red, coated with pale tomentum, and from an eighth to a quarter of an inch long. The aments of staminate flowers, which are produced in dark red-stemmed racemes from two to three inches in length, first appear at midsummer and are raised on short stout peduncles; during the winter they are about an inch and a quarter long and an eighth of an inch thick, and are covered with dark red-brown lustrous closely appressed scales, and when they are fully grown and the flowers open in very early spring before the unfolding of the leaves, they are from four to six inches in length and a quarter of an inch in thickness, with ovate acute orange-colored glabrous scales. The calyx is yellow and four-lobed, with ovate rounded lobes rather shorter than the four stamens, which have included filaments and yellow anthers. The pistillate aments are produced in short racemes, and are usually

inclosed during the winter in buds which are formed during the early summer and open in the spring; they are from one third to nearly one half of an inch long and about one sixteenth of an inch thick, with dark red acute scales and bright red styles. The strobiles are raised on stout orange-colored peduncles sometimes nearly half an inch in length, and are ovate or oblong, from half an inch to almost an inch long and from one third to one half of an inch broad, with truncate scales much thickened toward the apex, and orbicular or obovate nuts surrounded by narrow membranaceous wings.

Alnus Oregona ranges from Sitka,[1] where it often clothes mountain sides to elevations of three thousand feet above the sea, southward through the islands and coast ranges of British Columbia,[2] and through western Washington and Oregon and the cañons of the California coast ranges to those of the Santa Inez Mountains near Santa Barbara. A common tree by the banks of streams in all this region, *Alnus Oregona* grows to its largest size in the neighborhood of Puget Sound, where it springs up on moist soil and forms a considerable part of the forests that cover the banks of streams.

The wood of *Alnus Oregona* is light, soft, brittle and not strong, but close-grained and easily worked, with a satiny surface susceptible of receiving a beautiful polish; it is light brown tinged with red, with thick nearly white sapwood, and contains broad distinct medullary rays. The specific gravity of the absolutely dry wood is 0.4813, a cubic foot weighing 29.99 pounds. In Washington and Oregon it is now largely used in the manufacture of furniture, and by the Indians of Alaska the trunks are hollowed into canoes.[3]

First described from specimens gathered in 1830 in Sitka by Russian collectors, the Oregon Alder had been found in 1805 on the banks of the lower Columbia River by Lewis and Clark.[4]

[1] Ledebour, *Fl. Ross.* iii. 656. — Rothrock, *Rep. Smithsonian Inst.* 1867, 454 (*Fl. Alaska*).

[2] G. M. Dawson, *Can. Nat.* n. ser. ix. 231. — Macoun, *Cat. Can. Pl.* 437.

[3] Meehan, *Proc. Phil. Acad.* 1884, 91.

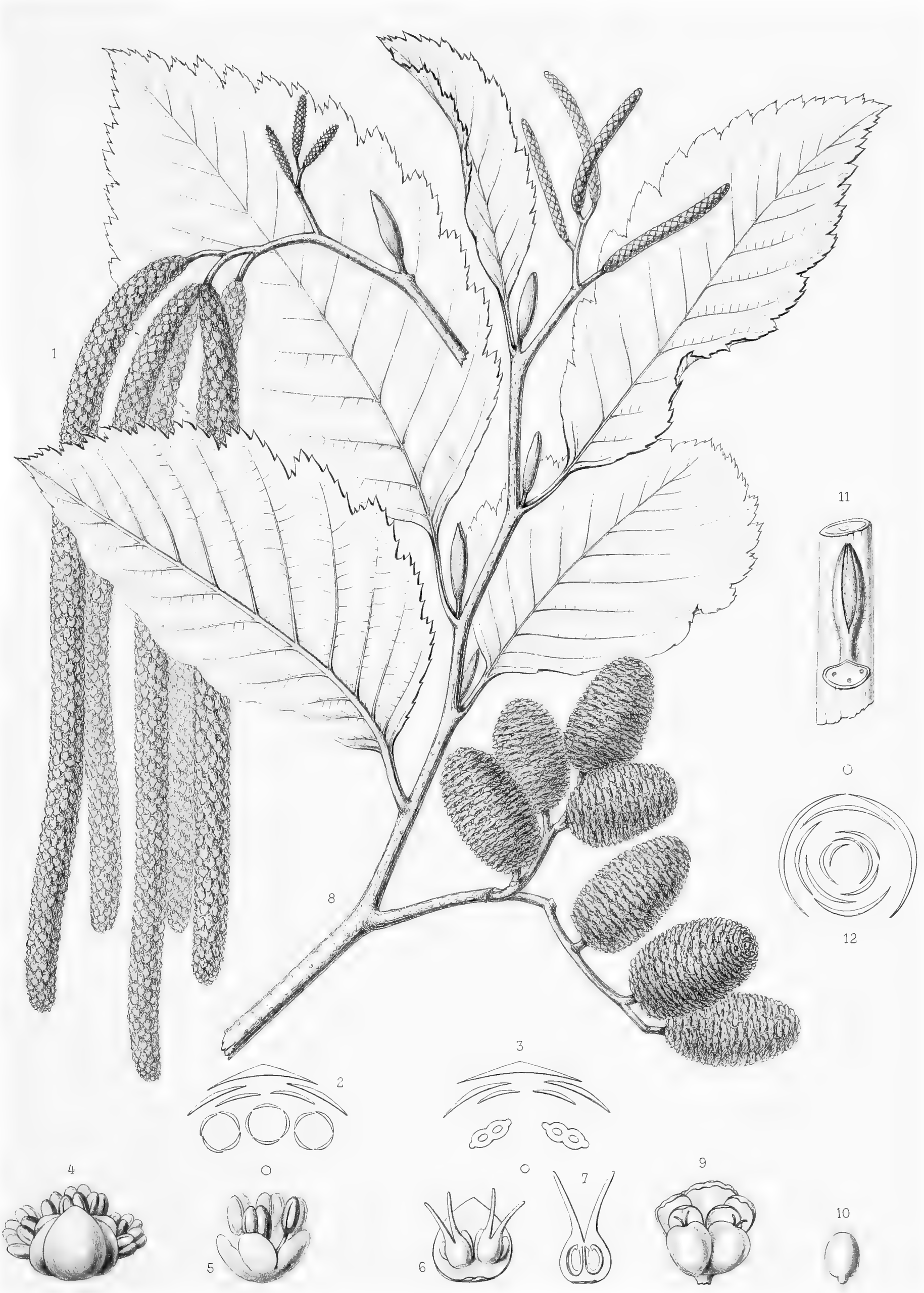
[4] *History of the Expedition under the Command of Lewis and Clark*, ed. Coues, ii. 689, 724, 749.

In the Alder of the lower Columbia River of Lewis and Clark the two arborescent species of the region are no doubt confounded.

EXPLANATION OF THE PLATE.

Plate CCCCLIV. Alnus Oregona.

1. A flowering branch, natural size.
2. Diagram of a staminate flower-cluster.
3. Diagram of a pistillate flower-cluster.
4. Scale of a staminate ament, rear view, with flowers, enlarged.
5. A staminate flower, enlarged.
6. Pistillate flowers with their scale, front view, enlarged.
7. Vertical section of a pistillate flower, enlarged.
8. A fruiting branch, natural size.
9. Scale of a strobile, front view, with nutlets, enlarged.
10. An embryo, enlarged.
11. A winter-bud and leaf-scar, enlarged.
12. Diagram of a leaf-bud.



C.E.Faxon del. *Rapine sc.*

ALNUS OREGONA, Nutt

A.Riocreux direx. *Imp. J.Taneur, Paris.*

ALNUS TENUIFOLIA.

Alder.

LEAVES ovate-oblong, glabrous or puberulous on the lower surface.

Alnus tenuifolia, Nuttall, *Sylva*, i. 32, t. 10 (1842).

? Alnus incana, β, Hooker, *Fl. Bor.-Am.* ii. 157 (1839).

Alnus incana, α **glauca**, Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 154 (*Monographia Betulacearum*) (in part) (1861); *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 433 (*Gattungen Betula und Alnus*) (in part); *De Candolle Prodr.* xvi. pt. ii. 189 (in part). — Watson, *King's Rep.* v. 323 (not Aiton); *Pl. Wheeler*, 17. — Macoun, *Rep. Geolog. Surv. Can.* 1875–76, 210. — Rothrock, *Wheeler's Rep.* vi. 239.

? Alnus serrulata, β **rugosa**, Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 433 (*Gattungen Betula und Alnus*) (1865); *De Candolle Prodr.* xvi. pt. ii. 188 (in part).

Alnus viridis? Cooper, *Am. Nat.* iii. 408 (1869).

Alnus incana, var. **virescens**, Watson, *Brewer & Watson Bot. Cal.* ii. 81 (1880). — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 165.

? Alnus rhombifolia, Macoun, *Cat. Can. Pl.* 438 (not Nuttall) (1883).

? Alnus occidentalis, Dippel, *Handb. Laubholzk.* ii. 158, f. 78 (1892). — Koehne, *Deutsche Dendr.* 114.

A tree, occasionally thirty feet tall, with a trunk six or eight inches in diameter, and slender spreading slightly pendulous branches which form a narrow round-topped head; or more often shrubby in habit, with several spreading stems, and at the north and at high elevations frequently not exceeding four or five feet in height. The bark of the trunk is not more than a quarter of an inch thick, light red-brown, generally smooth but broken on the surface into small closely appressed scales. The branchlets are slender, and when they first appear are marked with a few large orange-colored lenticels and coated with fine pale or rusty caducous pubescence; during their first winter they are light brown or ashy gray and more or less deeply flushed with red, and in their second season gradually grow paler and lose their lenticels. The winter-buds are from a quarter to a third of an inch in length, with bright red puberulous scales. The leaves are ovate-oblong, acute or acuminate, broad and rounded or cordate, or occasionally abruptly narrowed and wedge-shaped at the base, usually laciniately lobed, with acute lobes, and doubly serrate with nearly triangular spreading gland-tipped teeth; when they unfold they are light green often tinged with red, pilose on the upper surface and coated on the lower with pale tomentum, and at maturity they are thin and firm, dark green and glabrous above, pale yellow-green and glabrous or puberulous below, from two to four inches long and from one and a half to two and a half inches wide, with stout orange-colored midribs impressed on the upper side, slender primary veins running to the points of the lobes, rather conspicuous cross veinlets, and stout slightly grooved orange-colored petioles from half an inch to an inch in length. The stipules are ovate, acute, thin and scarious, half an inch long, about an eighth of an inch wide, and coated with pale pubescence. The aments of staminate flowers, three or four in number, are borne in slender-stemmed racemes about three inches in length, and are nearly sessile, or are raised on stout peduncles often half an inch long; during the winter they are naked, light purple, from three quarters of an inch to almost an inch in length and about a quarter of an inch thick, and when they are grown to full size and the flowers open with the unfolding of the leaves they are from an inch and a half to two inches long. The pistillate aments, which during the winter are naked, dark red-brown, and nearly a quarter of an inch long, with acute apiculate loosely imbricated scales, enlarge slightly in early spring before the appearance of the styles; and when fully grown the strobiles are ovate-oblong and from one third to one half of an inch in length, with scales that are much thickened and truncate or three-lobed at the apex, and nearly circular or slightly obovate nuts surrounded by thin membranaceous margins.

Alnus tenuifolia inhabits the banks of streams and mountain cañons, and is distributed from the

shores of Kicking Horse Lake[1] to the valley of the lower Fraser River in British Columbia, and southward through the Rocky Mountains to northern New Mexico, to the Sierra Nevada of southern California, and to Lower California.[2] In the northern interior region of the continent it is the common Alder by mountain streams; it is very abundant on the eastern slopes of the Cascade Mountains and of the California Sierras, and forms great shrubby thickets six or seven thousand feet above the sea along the head-waters of the rivers of southern California which flow to the Pacific Ocean; it is the common Alder of eastern Washington and Oregon, Idaho and Montana, and is very abundant in Colorado and northern New Mexico, where it grows to its largest size, often lining the banks of streams.

The wood, which has not been examined scientifically, is sometimes used for fuel.

Alnus tenuifolia was first distinguished by Thomas Nuttall,[3] who, in 1834, found it, during his journey across the continent, by the banks of small streams on the Blue Mountains of Oregon. Subsequently it was considered a variety of *Alnus incana*, the Speckled Alder of the northeastern part of the continent, but this differs from it in its thicker and less pointed rarely lobed leaves, pale and pubescent on the lower surface, its darker bark, and the conspicuous persistent white spots that cover its branches.

[1] Macoun, *Cat. Can. Pl.* 438 (*Alnus incana*, var. *virescens*).

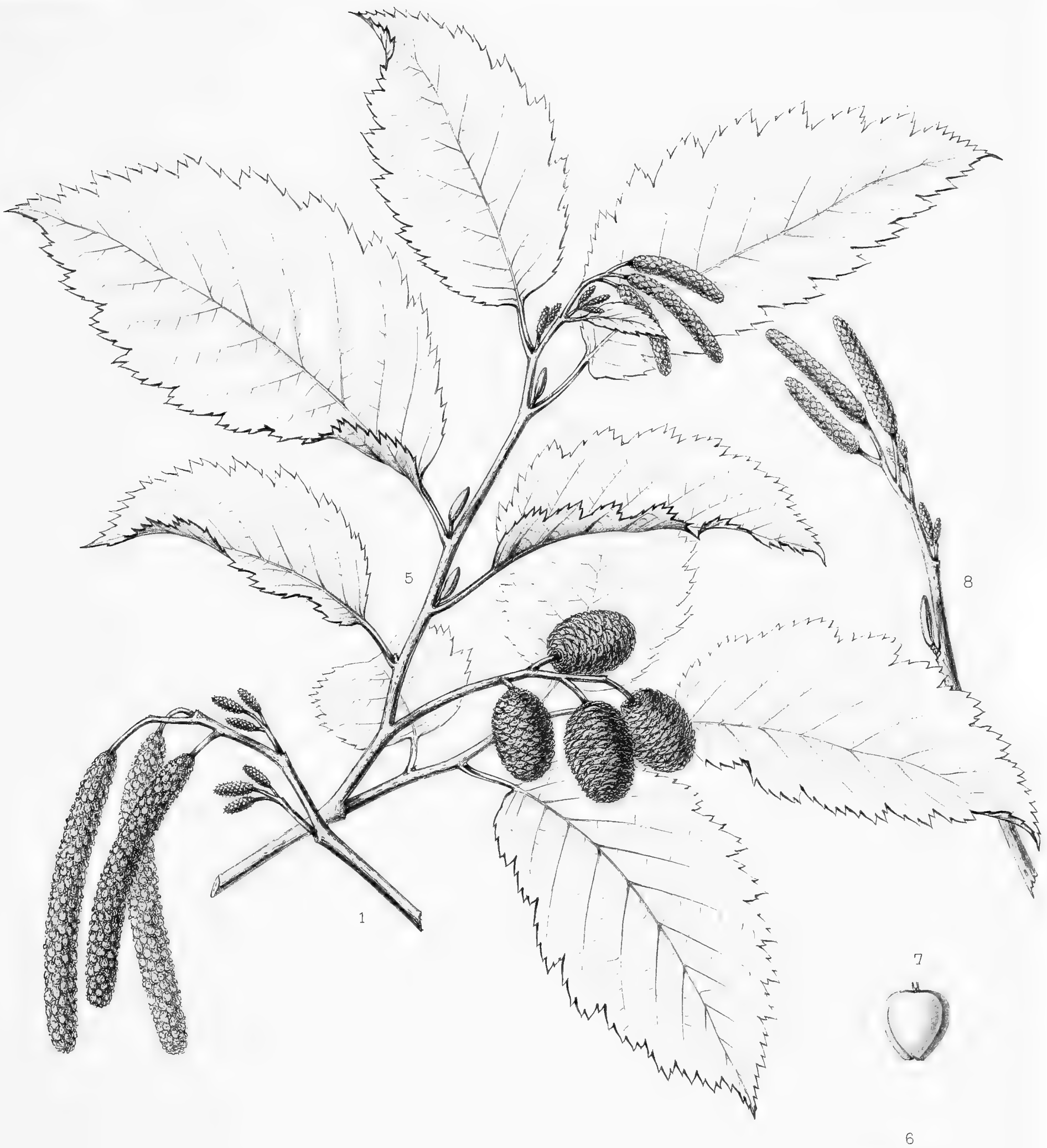
[2] Brandegee, *Zoë*, iv. 216 (*Alnus incana*, var. *virescens*).

[3] See ii. 34.

EXPLANATION OF THE PLATE.

Plate CCCCLV. Alnus tenuifolia.

1. A flowering branch, natural size.
2. Scale of a staminate ament, rear view, enlarged.
3. A staminate flower, enlarged.
4. Pistillate flowers with their scale, front view, enlarged.
5. A fruiting branch, natural size.
6. Scale of a strobile, enlarged.
7. A nut, enlarged.
8. A winter-bud, natural size.



C.E.Faxon del. *Rapine sc.*

ALNUS TENUIFOLIA. Nutt.

A.Riocreux direx.t *Imp. J.Taneur, Paris.*

ALNUS RHOMBIFOLIA.

Alder.

LEAVES ovate or oval, pale and slightly puberulous on the lower surface. Stamens usually 2.

Alnus rhombifolia, Nuttall, *Sylva*, i. 33 (1842). — Torrey, *Bot. Wilkes Explor. Exped.* 467. — Brewer & Watson, *Bot. Cal.* ii. 80 (in part). — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 163 (in part). — Parry, *Bull. Cal. Acad.* ii. 351 (in part). — Mayr, *Wald. Nordam.* 286, t. 5. — Coville, *Contrib. U. S. Nat. Herb.* iv. 195 (*Bot. Death Valley Exped.*). — S. B. Parish, *Zoë*, iv. 347. — Greene, *Man. Bot. Bay Region*, 298.

Alnus oblongifolia, Watson, *Brewer & Watson Bot. Cal.* ii. 80 (in part) (not Torrey) (1880). — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 163 (in part).

A tree, frequently seventy or eighty feet in height, with a tall straight trunk from two to three feet in diameter, long slender branches pendulous at the extremities, and a wide round-topped open head. The bark on old trunks is about an inch in thickness, dark brown, and irregularly divided into flat and often connected ridges, which are broken into oblong plates and are scaly on the surface with small closely appressed scales. The branchlets are slender and marked with small scattered lenticels, and when they first appear are light green and coated with pale caducous pubescence, but soon become dark orange-red and glabrous, and grow darker during the winter and the following summer. The buds are nearly half an inch long, very slender, dark red, and covered with pale scurfy pubescence. The leaves are ovate or oval, or sometimes nearly orbicular, rounded, or acute, especially on vigorous shoots, at the apex, gradually or abruptly narrowed and wedge-shaped at the base, finely or sometimes coarsely and occasionally doubly serrate with small spreading glandular teeth, and slightly thickened and reflexed on the somewhat undulate margins; when they unfold they are pale green and coated with deciduous matted white hairs; and when fully grown they are dark green and lustrous on the upper surface, which is frequently marked, especially along the midribs, with minute black glandular dots, light yellow-green and slightly puberulous on the lower surface, from two to three and a half inches long and from one and a half to two inches wide, with stout yellow midribs and primary veins, conspicuous reticulate cross veinlets and slender yellow hairy petioles flattened and grooved on the upper side and from one half to three quarters of an inch in length. The stipules are ovate, acute, scarious, puberulous, and about a quarter of an inch long. The aments of staminate flowers are borne in slender-stemmed pubescent racemes and are usually short-stalked; during the summer they are dark olive-brown, and lustrous, from three quarters of an inch to an inch in length and about a sixteenth of an inch thick; beginning to lengthen late in the autumn before the leaves have fallen, they are fully grown early in January, when they are from four to six inches long and a quarter of an inch thick, with dark orange-brown scales, and fall in February before the appearance of the new leaves. The calyx is yellow, with four ovate lobes rounded at the apex and rather shorter than the stamens, which are two or occasionally three in number or rarely single. The pistillate aments are borne in short pubescent racemes and emerge from the bud in December, and in January the styles protrude from between their broadly ovate rounded scales, and the ovaries are fertilized. The strobiles, which are oblong and from one third to one half of an inch in length, with thin scales slightly thickened and lobed at the apex, are fully grown at midsummer, but do not open and discharge their nuts until the trees are in flower in the following year. The nut is broadly ovate with a thin acute margin.

Alnus rhombifolia inhabits the banks of streams and is distributed from northern Idaho to the

eastern slopes of the Cascade Mountains of Washington and southeastern Oregon, southward through the California coast ranges, and along the western slopes of the Sierra Nevada, which it ascends to elevations of nearly four thousand feet above the level of the sea, and of the San Bernardino, San Jacinto, and Cuayamaca Mountains.

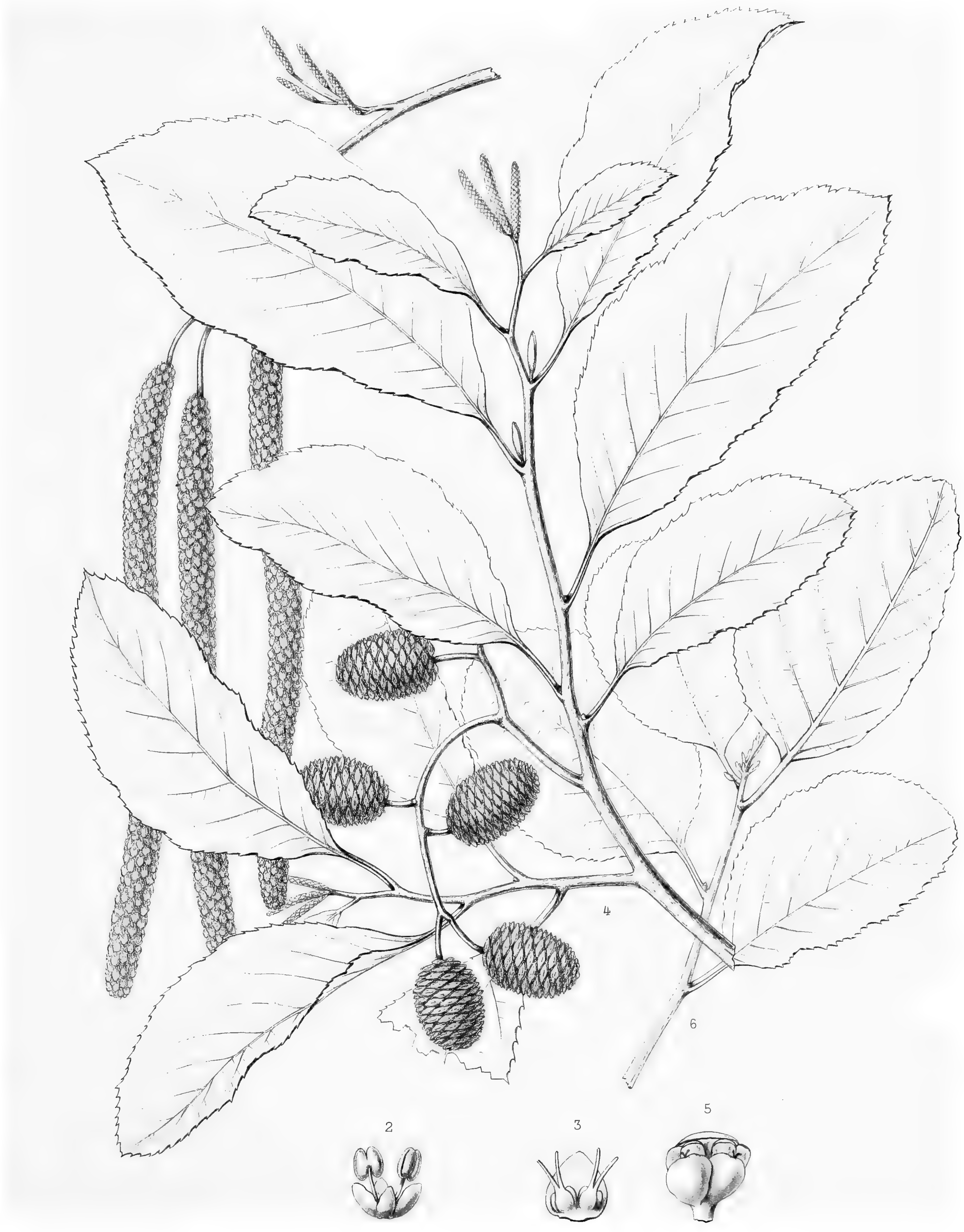
The wood of *Alnus rhombifolia* is light, soft, not strong, brittle, and close-grained; it is light brown, with thick lighter colored sapwood, which is often nearly white, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4024, a cubic foot weighing 25.06 pounds.

Alnus rhombifolia is the common Alder of the valleys of central California, where it is often a conspicuous object, especially in winter, when its long golden staminate aments, hanging on slender leafless branches, are bathed in the waters of mountain torrents. It is the only species in southern California; and was first distinguished by Thomas Nuttall in 1835 in the neighborhood of Monterey.

EXPLANATION OF THE PLATE.

PLATE CCCCLVI. ALNUS RHOMBIFOLIA.

1. A flowering branch, natural size.
2. A staminate flower, enlarged.
3. Pistillate flowers with their scale, front view, enlarged.
4. A fruiting branch, natural size.
5. Scale of a strobile, front view, with nutlets, enlarged.
6. A sterile branch, natural size.



C.E.Faxon del. Rapine sc.

ALNUS RHOMBIFOLIA, Nutt.

A.Riocreux direx.t Imp. J. Taneur, Paris.

ALNUS ACUMINATA.

Alder.

LEAVES oblong-lanceolate, acute, pale and sometimes puberulous on the lower surface.

Alnus acuminata, Humboldt, Bonpland & Kunth, *Nov. Gen. et Spec.* ii. 20 (1817). — Kunth, *Syn. Pl. Æquin.* i. 363. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 204 (*Revisio Betulacearum*).

Alnus oblongifolia, Torrey, *Bot. Mex. Bound. Surv.* 204 (1859). — Watson, *Pl. Wheeler*, 17. — Rothrock, *Wheeler's Rep.* vi. 239. — Brewer & Watson, *Bot. Cal.* ii. 80 (in part). — Rusby, *Bull. Torrey Bot. Club*, ix. 79. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 163 (in part). — Mayr, *Wald. Nordam.* 286.

Alnus acuminata, *α* **genuina**, Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 147 (*Monographia Betulacearum*) (1860); *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 424 (*Gattungen Betula und Alnus*); *De Candolle Prodr.* xvi. pt. ii. 184.

Alnus serrulata, *γ* **oblongifolia**, Regel, *De Candolle Prodr.* xvi. pt. ii. 188 (1868).

Alnus rhombifolia, Parry, *Bull. Cal. Acad.* ii. 351 (in part) (not Nuttall) (1887).

? Alnus Jorullensis, var. **acuminata**, Otto Kuntze, *Rev. Gen. Pl.* ii. 638 (1891).

In the United States a tree, rarely more than twenty or thirty feet in height, with a trunk sometimes eight or ten inches in diameter, and long slender spreading branches which form an open round-topped head. The bark of the trunk is thin, smooth, and light brown tinged with red. The branchlets are slender, slightly puberulous while young, and during their first winter light orange-red and lustrous, and marked with small conspicuous pale lenticels; in their second year they are dark red-brown or gray tinged with red, and much roughened by the elevated leaf-scars. The buds are acute, bright red, lustrous, glabrous, and half an inch in length. The leaves are oblong-lanceolate and acute or rarely obovate and rounded at the apex, gradually narrowed and wedge-shaped at the base, sharply and usually doubly serrate with small spreading glandular teeth, more or less thickly covered, especially early in the season, with minute black glands, dark yellow-green and glabrous, or very slightly puberulous on the upper surface, and on the lower surface pale and glabrous, or puberulous, especially along the slender yellow midribs and veins, and furnished with small tufts of rusty hairs in the axils of the primary veins; they are from two to three inches long and about an inch and a half wide, and, borne on slender yellow pubescent grooved petioles three quarters of an inch long, fall in the late autumn or early winter. The stipules are ovate-lanceolate, brown and scarious, and about a quarter of an inch in length. The aments of staminate flowers are produced in short stout-stemmed racemes, and during the winter are light yellow, from one half to three quarters of an inch in length and about a sixteenth of an inch thick; they are fully grown when the flowers open at the end of February or early in March before the appearance of the leaves, and are then from two to two and a half inches long, with ovate pointed dark orange-brown scales. The flowers contain usually three, but occasionally two stamens with anthers which are pale red when they first appear, but soon turn light yellow. The pistillate aments, which are naked during the winter, are from an eighth to nearly a quarter of an inch long when the bright red stigmas protrude from between the light brown ovate rounded scales. The strobiles vary from half an inch to nearly an inch in length, with thin scales slightly thickened and nearly truncate at the apex. The nut is broadly ovate, with a narrow membranaceous border.

Within the territory of the United States, where it was found in 1851 by Charles Wright,[1] the botanist of the Mexican Boundary Survey, on the banks of the Mimbres River, *Alnus acuminata* inhabits only the cañons of the mountains of southern New Mexico and Arizona, growing, at elevations

[1] See i. 94.

of between four and six thousand feet above the sea-level, along the banks of streams with Willows, Sycamores, and Walnuts. It is common in the mountain cañons of northern Mexico, and ranges through southern Mexico and Central America to the Andes of Peru, where the species was discovered by Humboldt.[1]

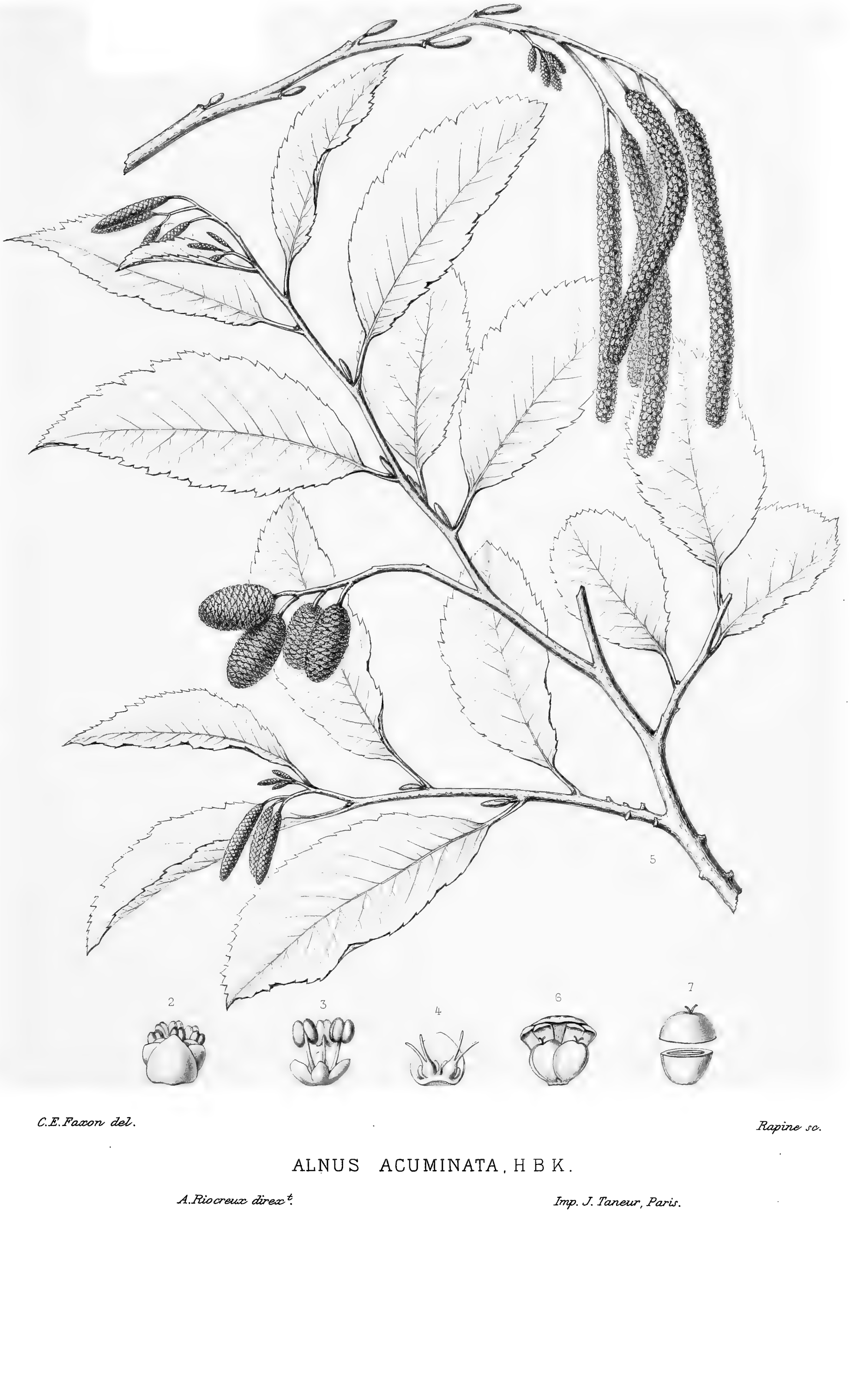
The wood of *Alnus acuminata* has not been examined.

[1] Several of the so-called varieties of this species from Mexico and Central America, if judged only by the fragments preserved in herbaria, might be considered species. The following, however, appear to be identical with the tree of New Mexico and Arizona: Bourgeau, No. 244, City of Mexico. — Lumholtz, No. 323, Sierra Madre. — Pringle, No. 5057, State of Michoacan, near Patzcuaro. — Pringle, No. 4361, Valley of Mexico. — Nelson, No. 1956, Huajupan. Better knowledge than is now obtainable with regard to the Mexican and Central American Alders may show that the species of northern Mexico is distinct from the Andean *Alnus acuminata*, in which case the name for this tree would appear to be *Alnus oblongifolia* of Torrey.

EXPLANATION OF THE PLATE.

PLATE CCCCLVII. ALNUS ACUMINATA.

1. A flowering branch, natural size.
2. Scale of a staminate ament, rear view, with flowers, enlarged.
3. A staminate flower, enlarged.
4. Pistillate flowers with their scale, front view, enlarged.
5. A fruiting branch, natural size.
6. Scale of a strobile, front view, with nuts, enlarged.
7. A nut cut transversely, enlarged.



C.E. Faxon del. *Rapine sc.*

ALNUS ACUMINATA, H B K.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

ALNUS MARITIMA.

Seaside Alder.

LEAVES oblong, ovate or obovate, dark green and lustrous above, pale yellow-green below. Flowers autumnal.

Alnus maritima, Nuttall, *Sylva*, i. 34, t. 10 bis (1842). — Canby, *Proc. Phil. Acad.* 1864, 18; *Bot. Gazette*, vi. 270. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 162 (excl. hab. Manchuria and Japan); *Garden and Forest*, iv. 268, f. 47. — Mayr, *Wald. Nordam.* 185. — Watson & Coulter, *Gray's Man.* ed. 6, 473. — Herder, *Act. Hort. Petrop.* xii. 73 (*Pl. Radd.*) (excl. γ *arguta*).

Betula-Alnus maritima, Marshall, *Arbust. Am.* 20 (1785).

Alnus oblongata, Regel, *Nouv. Mém. Soc. Nat. Mosc.* xiii. 171, t. 6, f. 3–9 (*Monographia Betulacearum*) (in part) (not Willdenow) (1860). — Dippel, *Handb. Laubholzk.* ii. 151. — Koehne, *Deutsche Dendr.* 113.

Alnus maritima, α **typica**, Regel, *Bull. Soc. Nat. Mosc.* xxxviii. pt. ii. 427 (*Gattungen Betula und Alnus*) (1865); *De Candolle Prodr.* xvi. pt. ii. 186.

A tree, occasionally thirty feet in height, with a tall straight trunk four or five inches in diameter, and slender spreading branches which form a narrow round-topped head; or more often shrubby, with numerous slender spreading stems fifteen or twenty feet high. The bark of the trunk is about an eighth of an inch thick and is smooth and light brown or brown tinged with gray. The branchlets are slender and slightly zigzag, and when they first appear are light green and hairy; during their first summer they are pale yellow-green, very lustrous, slightly puberulous, marked with occasional small orange-colored lenticels, and covered with minute dark glandular dots; they turn dull light orange or reddish brown in the winter, when the pale lenticels become rather conspicuous, and ashy gray often slightly tinged with red in the following season. The buds are acute, dark red, coated with pale lustrous scurfy pubescence, and about a quarter of an inch long. The leaves are oblong, ovate or obovate, acute, acuminate or rounded at the apex, gradually narrowed and wedge-shaped at the base, remotely serrate with minute incurved glandular teeth, and somewhat thickened on the slightly undulate margins; when they unfold they are light green tinged with red, hairy on the midribs, veins, and petioles, and coated above with pale scurfy pubescence; and when fully grown they are dark green, very lustrous, and covered with minute pale glandular dots on the lower surface, three or four inches long and from an inch and a half to two inches wide, with stout yellow midribs and primary veins which are prominent and marked with dark glands above and are slightly puberulous below, coarse reticulate veinlets, and stout grooved yellow glandular puberulous petioles flattened and grooved on the upper side, and from one half to three quarters of an inch in length. The stipules are oblong, acute, about an eighth of an inch long, dark reddish brown, and caducous. The flower aments appear in July on branches of the year, the staminate in short scurfy pubescent glandular punctate racemes from the axils of the upper leaves, and the pistillate usually solitary from those of lower leaves, and are fully grown in August or early in September, when the flowers expand. While they are growing the staminate aments are covered with ovate acute dark green and very lustrous scales slightly ciliate on the margins and furnished at the apex with minute red points, and at maturity they are from one and a half to two and a half inches in length and from one quarter to nearly one half of an inch in thickness, with dark orange-brown scales raised on slender stalks from an eighth to a quarter of an inch long, and bright orange-colored stamens, and are borne on slender peduncles sometimes a third of an inch in length. The pistillate aments are raised on stout pubescent peduncles, and before opening are bright red at the apex and light green below, with ovate acute scales slightly ciliate on the margins; when the styles protrude from between the scales the aments are about an eighth of an inch long; during the autumn and winter they

do not enlarge, but early in the spring begin to grow, and attain their full size at midsummer, when they are broadly ovate, rounded and depressed at the base, gradually narrowed to the rather obtuse apex, about five eighths of an inch long and half an inch broad, with thin broadly obovate dark green and very lustrous scales slightly thickened and crenately lobed at the apex, which is now often tinged with brown and from which the withered styles still protrude; they are borne on stout glandular pubescent peduncles about a third of an inch in length, and turn dark reddish brown or nearly black and open late in the autumn, remaining on the branches until after the flowers unfold in the following year. The nut is oblong-obovate, gradually narrowed, and apiculate at the apex, with a thin membranaceous border.

Alnus maritima inhabits the banks of streams and ponds in the southern part of the peninsula of Delaware and Maryland, growing usually near but not immediately upon the seacoast; it also occurs in the centre of the peninsula, being abundant on the banks of the Nanticoke River near Seaford, Delaware, where it flourishes with the Sour Gum, the Red Maple, the Bald Cypress, the White Cedar, and other swamp trees at the head of tide-water, and on the Wicomico River near Salisbury in Maryland. It also grows on the banks of the Red River in the Indian Territory.[1]

The wood of *Alnus maritima* is light, soft, and close-grained; it is light brown, with thick hardly distinguishable sapwood, and contains numerous broad conspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.4996, a cubic foot weighing 31.13 pounds.

Alnus maritima was introduced into cultivation by Mr. Thomas Meehan,[2] by whom it was sent in 1878 to the Arnold Arboretum, where it is hardy and flowers and fruits abundantly. Its brilliant foliage and its bright golden staminate aments, hanging in September from the ends of the slender leafy branches, make it at that season of the year an attractive ornament for parks and gardens.

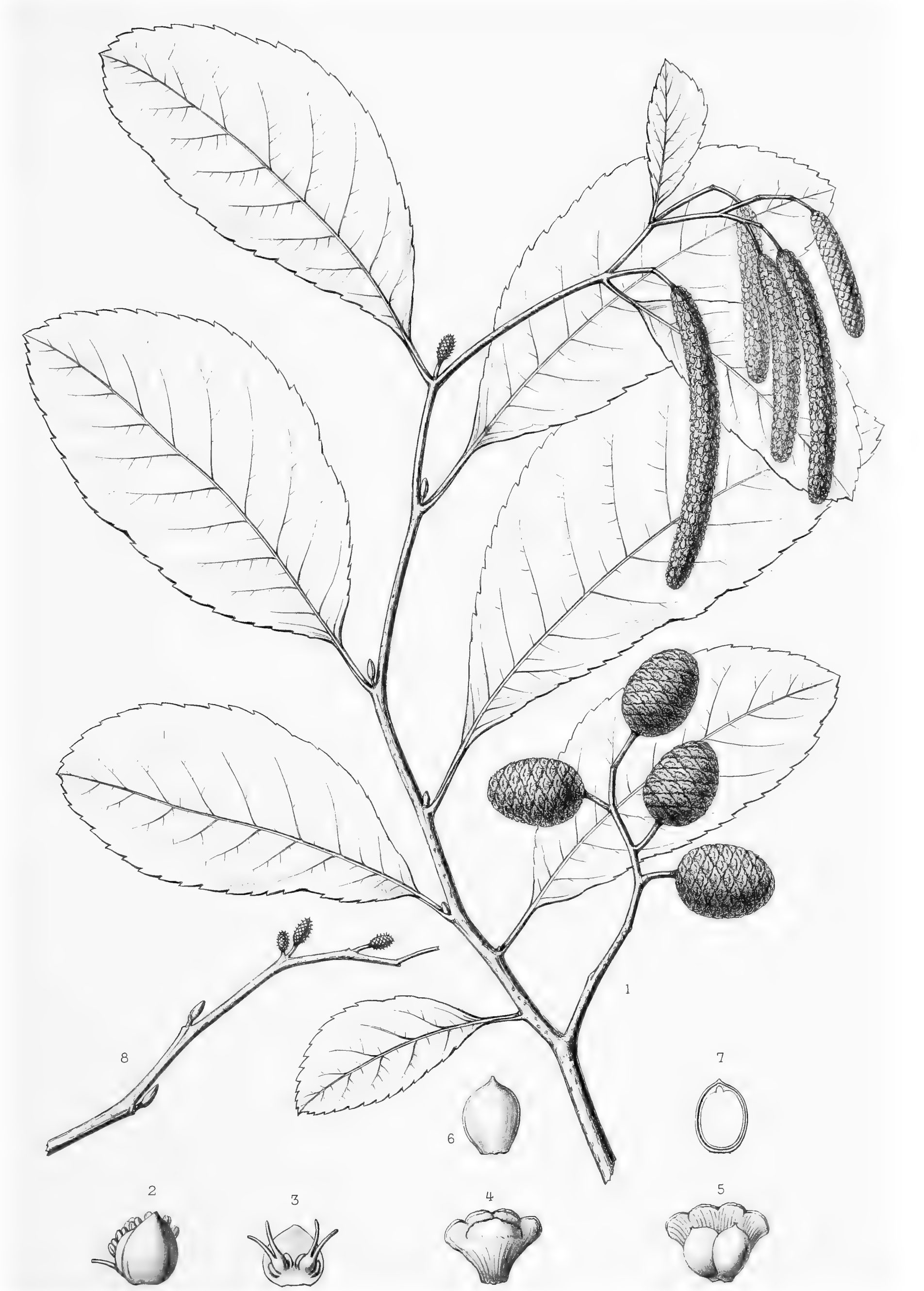
[1] *Alnus maritima* was discovered on the Red River on July 10, 1872, by Mr. Elihu Hall (*Plantæ Texanæ*, No. 612).

[2] Thomas Meehan was born at Potter's Bar, a village near Barnet on the borders of Middlesex, England, on the 4th of March, 1826. From his father, who for nearly half a century was gardener to Colonel Francis Vernon-Harcourt at the Castle of St. Clare in the Isle of Wight, he learned the art of gardening, and then, after two years' service in the Royal Gardens at Kew, came to America in his twenty-second year on the invitation of Mr. Robert Buist, the Philadelphia florist. In 1853 Mr. Meehan established the nursery in Germantown which he still carries on and which has been a most important factor in increasing the cultivation of American trees and shrubs. For fifteen years Mr. Meehan was one of the editors of *Forney's Press*, and for many years the editor of *The Gardener's Monthly*, the principal horticultural journal of its time in the United States. In 1878 he began the publication of the *Native Flowers and Ferns of the United States*, a work illustrated with chromo-lithographs, of which four volumes appeared. This in 1891 was followed by *Meehan's Monthly, A Magazine of Horticulture, Botany, and Kindred Subjects*. Mr. Meehan has long taken a prominent part in the management of the affairs of his adopted city, serving as one of the Board of School Directors and as a member of the City Councils; and it is through his intelligence and zeal that Philadelphia has secured the small parks which are now scattered through the city. Active also in the management of the Academy of Natural Sciences of Philadelphia, the records of Mr. Meehan's numerous observations upon the habits of plants are found scattered through the printed pages of its Proceedings. For many years he served the State Board of Agriculture as professor of botany. Mr. Meehan has taken a permanent place in the horticulture of the second half of the nineteenth century in his adopted country.

EXPLANATION OF THE PLATE.

PLATE CCCCLVIII. ALNUS MARITIMA.

1. A flowering and fruiting branch, natural size.
2. Staminate flowers with their scale, side view, enlarged.
3. Pistillate flowers with their scale, front view, enlarged.
4. Scale of a strobile, rear view, enlarged.
5. Scale of a strobile, front view, with nuts, enlarged.
6. A nut, enlarged.
7. Vertical section of a nut, enlarged.
8. A winter branch, natural size.



C.E.Faxon del. *Rapine sc.*

ALNUS MARITIMA, Nutt.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*

MYRICA.

Flowers naked, unisexual, monœcious or diœcious, in unisexual or androgynous aments; stamens usually 4 to 6; ovary 1-celled; ovule solitary, erect. Fruit drupaceous. Leaves alternate, resinous-punctate, usually without stipules, deciduous or persistent.

Myrica, Linnæus, *Gen.* 302 (1737). — A. L. de Jussieu, *Gen.* 409. — Endlicher, *Gen.* 271. — Meisner, *Gen.* 351. — Baillon, *Hist. Pl.* vi. 259. — Bentham & Hooker, *Gen.* iii. 400. — Engler, *Engler & Prantl Pflanzenfam.* iii. pt. i. 27.
Gale, Adanson, *Fam. Pl.* ii. 345 (1763).
Morella, Loureiro, *Fl. Cochin.* 548 (1790).
Comptonia, Gærtner, *Fruct.* ii. 58, t. 90 (1791). — Schreber, *Gen.* ii. 811. — Nuttall, *Gen.* ii. 206.
Cerophora, Rafinesque, *Alsograph. Am.* 11 (1838).
Fayana, Rafinesque, *Alsograph. Am.* 12 (1838).
Faya, Webb & Berthelot, *Phytogr. Canar.* sect. iii. 272 (not Necker) (1850).

Aromatic resinous trees or shrubs, with watery juice, terete branches, scaly leaf-buds formed in summer, the scales of the inner rows accrescent, and fibrous often stoloniferous roots. Leaves alternate, revolute in vernation, serrate, irregularly dentate or lobed, rarely entire or pinnatifid, penniveined with obscure veins, resinous-punctate, usually coriaceous, deciduous or persistent, generally exstipulate, or furnished with fugacious stipules, leaving, when they fall, elevated semiorbicular leaf-scars displaying the ends of three nearly equidistant fibro-vascular bundles. Flowers monœcious or diœcious in the axils of the deciduous scales of unisexual or rarely androgynous aments from scaly buds formed in summer in the axils of the leaves of the year, remaining covered during the winter, and opening in early spring before or with the unfolding of the leaves of the year; in monœcious species the sterile aments in the axils of lower, the fertile in those of upper leaves. Staminate flowers in oblong or cylindrical simple fascicled or densely panicled aments, below the pistillate in androgynous aments. Stamens from two to sixteen, generally from four to six, inserted on the torus-like base of the scales of the ament, usually subtended by two or four or rarely by numerous scale-like bractlets; filaments filiform, short or elongated, free or united at the base into a short stipe; anthers ovate, erect, two-celled, introrse, opening longitudinally; ovary rudimentary, subulate, usually wanting. Pistillate flowers in ovoid or globular catkins shorter or longer than those of the staminate flowers, their scales one or rarely two or three-flowered. Ovary sessile, one-celled, usually subtended by two lateral bractlets persistent under the fruit, or (Comptonia) by eight linear subulate bractlets accrescent and forming a laciniately cut rigid involucre inclosing the fruit; styles short, divided into two elongated filiform or abbreviated stigmas stigmatic on the inner face; ovule solitary, erect from the bottom of the cell, orthotropous, the micropyle superior. Drupe globose or ovoid; exocarp papillose and often covered with a waxy exudation, rarely thick, fleshy and succulent, or (Gale) smooth and resinous; endocarp thick, hard, and bony. Seed erect, exalbuminous, covered with a thin membranaceous testa. Embryo straight; cotyledons plano-convex, fleshy; radicle short, superior, turned away from the minute basal hilum.[1]

[1] By Engler (Engler & Prantl, *Pflanzenfam.* iii. pt. i. 27) Myrica is divided into the following sections: —

Morella. Flowers diœcious or monœcious; staminate flowers subtended by two to four or (*Myrica sapida*) by numerous scale-like bractlets, or ebracteolate; pistillate flowers solitary or in from two to four-flowered clusters, subtended by two bractlets persistent under the fruit. Pericarp papillose, covered with a waxy secretion, or rarely (*Myrica sapida*) succulent and fleshy. Leaves serrate or rarely entire.

Gale. Flowers diœcious; pistillate flowers subtended by two

The species of Myrica, of which about thirty are known, are shrubs or small trees, and are widely distributed through the temperate and warmer parts of the world.[1] In North America seven species are distinguished; three of them are small seacoast trees and four are shrubs. Of the shrubby North American species, *Myrica Gale*,[2] which also inhabits northern and central Europe, northern continental Asia, Saghalin, and northern Japan, is distributed through northern regions from the shores of the Atlantic Ocean to those of the Pacific. *Myrica Caroliniensis*[3] grows on sand dunes and sterile hills in the neighborhood of the sea from Nova Scotia to Louisiana, and on the borders of the Great Lakes. *Myrica peregrina*[4] is widely distributed from Nova Scotia to the Saskatchewan, and southward through the northern states and along the Alleghany Mountains to North Carolina and Tennessee; and in California *Myrica Hartwegi*[5] inhabits the high mountains of the central part of the state. Several species are indigenous to the West Indies,[6] Mexico, Central America, and northern and western South

bractlets, accrescent and forming lateral wings on the fruit. Pericarp smooth and resinous. Leaves serrate.

COMPTONIA. Flowers usually monœcious; pistillate flowers surrounded by eight linear subulate bractlets accrescent and forming a spiny involucre to the fruit. Pericarp smooth, resinous, and lustrous. Leaves pinnatifid.

[1] C. de Candolle, *Prodr.* xvi. pt. ii. 147.

[2] Linnæus, *Spec.* 1024 (1753). — Oeder, *Fl. Dan.* ii. t. 825. — Smith & Sowerby, *English Bot.* viii. 562, t. 562. — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 301. — Mirbel, *Mém. Mus.* xiv. 477, t. 28, f. — *Nouveau Duhamel*, ii. 194, t. 57. — Guimpel, Willdenow & Hayne, *Abbild. Deutsch. Holz.* ii. 260, t. 200. — Bongard, *Mém. Phys. Math. et Nat. pt. ii. Acad. Sci. St. Pétersbourg*, ii. 162 (*Vég. Sitcha*). — Hooker, *Fl. Bor.-Am.* ii. 160. — Reichenbach, *Icon. Fl. German.* xi. 30, t. 620. — Ledebour, *Fl. Ross.* iii. 661. — Maximowicz, *Mém. Acad. Sci. St. Pétersbourg*, ix. 259 (*Prim. Fl. Amur.*). — C. de Candolle, *l. c.* — F. Schmidt, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, xii. 175 (*Reisen im Amur-Lande*). — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 234; Suppl. 57. — Macoun, *Cat. Can. Pl.* 434. — Watson & Coulter, *Gray's Man.* ed. 6, 469. — Kurz, *Bot. Jahrb.* xix. 404 (*Fl. Chilcatgebietes*).

Myrica palustris, Lamarck, *Fl. Franç.* ii. 236 (1778).

Myrica Brabantica, J. E. Gray, *Nat. Arr. Brit. Pl.* ii. 249 (1821).

Gale Belgica, Dumortier, *Fl. Belg.* 12 (1827).

Cerophora angustifolia, Rafinesque, *Alsograph. Am.* 11 (1838).

Cerophora spicans, Rafinesque, *l. c.* 12 (1838).

Gale uliginosa, Spach, *Hist. Vég.* xi. 259, t. 97 (1842).

Myrica Gale, β *tomentosa*, C. de Candolle, *l. c.* 148 (1864).

Myrica Gale, γ *Portugalensis*, C. de Candolle, *l. c.* (1864).

Astringent and pectoral aromatic properties are ascribed to *Myrica Gale*, and an infusion of the leaves is used to cure the itch or is given internally as a vermifuge. The leaves sometimes serve in northern Europe as a substitute for hops; all parts of the plant are utilized in dyeing and tanning, and an infusion of the leaves is employed in Europe as an insecticide (Loudon, *Arb. Brit.* iv. 2056. — Beringer, *Am. Jour. Pharm.* lxvi. 220); and gale-oil with a pleasant balsamic odor and styptic flavor is distilled from them (Spons, *Encyclopædia of the Industrial Arts, Manufactures, and Raw Commercial Products*, ii. 1421).

[3] Miller, *Dict.* ed. 8, No. 3 (1768). — Wangenheim, *Nordam. Holz.* 102. — Willdenow, *Spec.* iv. pt. ii. 746; *Enum.* 1011. — Aiton, *Hort. Kew.* ed. 2, v. 379. — Pursh, *Fl. Am. Sept.* ii. 620. — Nuttall, *Gen.* ii. 235. — Elliott, *Sk.* ii. 678. — Sargent, *Garden and Forest*, vii. 476, f. 76.

Myrica cerifera, β, Linnæus, *l. c.* (1753). — Lamarck, *Dict.* ii. 592.

? *Myrica cerifera humilis*, Marshall, *Arbust. Am.* 95 (1785).

Myrica cerifera, β *latifolia*, Aiton, *Hort. Kew.* iii. 396 (1789).

Myrica Pensylvanica, Loiseleur-Deslongchamps, *Nouveau Duhamel*, ii. 190, t. 55 (1802 ?). — Desfontaines, *Hist. Arb.* ii. 472. — Pursh, *l. c.* — Sprengel, *Syst.* i. 493. — Rafinesque, *l. c.* 10. — Spach, *l. c.* 262. — Jaume St. Hilaire, *Traité des Arbres*, ii. t. 107.

Myrica cerifera, β *media*, Michaux, *Fl. Bor.-Am.* ii. 228 (1803). — *Nouveau Duhamel*, ii. 190. — Chapman, *Fl.* 427.

Myrica cerifera, Bigelow, *Fl. Boston.* 240 (not Linnæus) (1814); *Med. Fl.* iii. 32, t. 43. — Schmidt, *Oestr. Baumz.* iv. 49, t. 232. — Torrey, *Compend. Fl. N. States*, 372; *Fl. N. Y.* ii. 197. — Gray, *Man.* 420. — Emerson, *Trees Mass.* 224; ed. 2, i. 256, t. — Watson & Coulter, *l. c.* 470 (in part).

Myrica sessilifolia, Rafinesque, *l. c.* 10 (1838).

Myrica sessilifolia, var. *latifolia*, Rafinesque, *l. c.* 10 (1838).

[4] Otto Kuntze, *Rev. Gen. Pl.* ii. 638 (1891).

Liquidambar peregrina, Linnæus, *Spec.* 999 (1753). — Murray, *Syst.* 705.

Myrica asplenifolia, Linnæus, *l. c.* 1024 (1753). — Watson & Coulter, *l. c.*

Liquidambar asplenifolia, Linnæus, *Syst.* ed. 10, 1273 (1759); *Spec.* ed. 2, 1418 — Marshall, *l. c.* 77. — Schmidt, *l. c.* ii. 3, t. 61.

Comptonia asplenifolia, Aiton, *l. c.* 334 (1789). — Gærtner, *Fruct.* ii. 58, t. 90. — Michaux, *l. c.* ii. 203. — Willdenow, *Spec.* iv. pt. i. 320. — *Nouveau Duhamel*, ii. 46, t. 11. — Bigelow, *l. c.* 219. — Pursh, *l. c.* 635. — Elliott, *l. c.* ii. 562. — Nuttall, *l. c.* ii. 206. — Watson, *Dendr. Brit.* ii. 166, t. 166. — Emerson, *l. c.* 225; ed. 2, i. 258, t. — Torrey, *Fl. N. Y.* ii. 198. — Gray, *l. c.* 421. — Chapman, *l. c.*

Myrica Comptonia, C. de Candolle, *l. c.* 151 (1864).

Sweet Fern, as this shrub is popularly called, is tonic and astringent, and in domestic practice is sometimes used in decoctions as a remedy for diarrhœa and colic (Linnæus, *Amœn.* iv. 522 [*Liquidambar peregrina*]. — Schoepf, *Mat. Med. Amer.* 142. — Barton, *Coll.* i. 10. — W. P. C. Barton, *Mat. Med.* i. 221, t. 19. — Stokes, *Bot. Mat. Med.* iv. 348. — Chiles, *Am. Jour. Pharm.* xlv. 304. — Johnson, *Man. Med. Bot. N. Am.* 251. — Parke, Davis & Co., *Organic Mat. Med.* 176. — *U. S. Dispens.* ed. 16, 1765. — Beringer, *l. c.* 221).

[5] Watson, *Proc. Am. Acad.* x. 350 (1875). — Brewer & Watson, *Bot. Cal.* ii. 81.

Myrica Gale, Bentham, *Pl. Hartweg.* 336 (not Linnæus) (1857).

[6] Grisebach, *Fl. Brit. W. Ind.* 177; *Cat. Pl. Cub.* 69. — Urban, *Bot. Jahrb.* xv. 357.

America.[1] One species[2] inhabits the Atlantic islands and southeastern Europe; the genus has several representatives in southern Africa,[3] and is found in Madagascar[4] and Abyssinia,[5] southern Asia,[6] the Malayan Archipelago,[7] the Pacific islands,[8] and China and Japan.[9] Myrica existed in North America and in Europe during the cretaceous period, and the tertiary rocks of Europe show what are believed to be the remains of a great number of species. In North America the number of species seems to have increased slowly, and it is only in the Parks and Green River groups of the upper tertiary period that numerous forms appear with several species referable to the section Comptonia, now represented by a single living species of eastern North America.[10]

Wax is obtained from the exudations of the fruit of several species,[11] especially from that of the North American *Myrica cerifera* and *Myrica Caroliniensis*, the South American *Myrica pubescens*,[12] and the south African *Myrica cordifolia*.[13] The bark of Myrica is astringent[14] and is sometimes used as

[1] Humboldt, Bonpland & Kunth, *Nov. Gen. et Spec.* ii. 16. — Kunth, *Syn. Pl. Æquin.* i. 361. — Bentham, *Pl. Hartweg.* 71, 157, 251, 266, 354. — Martens & Galeotti, *Bull. Acad. Brux.* x. pt. ii. 134. — Hemsley, *Bot. Biol. Am. Cent.* iii. 164.

[2] *Myrica Faya*, Aiton, *Hort. Kew.* iii. 397 (1789). — Brotero, *Fl. Lusitan.* i. 211. — *Nouveau Duhamel*, ii. 194, t. 56. — C. de Candolle, *Prodr.* xvi. pt. ii. 152. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 234.

Fayana Azorica, Rafinesque, *Alsograph. Am.* 12 (1838).

Faya fagifera, Webb & Berthelot, *Phytogr. Canar.* sect. iii. 272, t. 216 (1850).

[3] Thunberg, *Fl. Cap.* ed. Schultes, 153. — Chamisso, *Linnæa*, vi. 535.

[4] Mirbel, *Mém. Mus.* xiv. 474, t. 28, f. 1. — Baker, *Jour. Linn. Soc.* xx. 267.

[5] A. Richard, *Tent. Fl. Abyss.* ii. 277.

[6] Hooker f. *Fl. Brit. Ind.* v. 597.

[7] Blume, *Bijdr. Fl. Ned. Ind.* 517; *Fl. Jav.* iii. 5. — Miquel, *Fl. Ind. Bat.* i. 871.

[8] Rolfe *Jour. Linn. Soc.* xxi. 316.

[9] Bentham. *Fl. Hongk.* 322. — Franchet & Savatier, *Enum. Pl. Jap.* i. 454. — Hance, *Jour. Bot.* xxi. 357.

[10] Lesquereux, *Rep. U. S. Geolog. Surv.* vii. 126, t. 16, f. 3–10; t. 17, f. 5–15, 17; t. 64, f. 1; t. 65, f. 7–9; viii. 145, t. 25, f. 1–6, 15; t. 26, f. 1–14; t. 32, f. 8–18; t. 45[a], f. 10–15 (*Contrib. Fossil Fl. W. Territories*, ii., iii.). — Saporta, *Origine Paléontologique des Arbres*, 140. — Zittel, *Handb. Palæontolog.* ii. 452.

[11] Myrica wax is obtained by boiling the fruit and straining the supernatant wax through cotton cloth. Formerly largely manufactured domestically and used in the United States for illuminating, it is now rarely made in this country, and is probably employed only to adulterate beeswax and in domestic practice in the treatment of diarrhœa. Myrica wax is pale yellow or grayish green, has a faint odor and a slightly bitter taste, and is insoluble in water. (See Cadet, *Annales de Chimie*, xliv. 140 [*Sur l'arbre cirier de la Louisiane et de la Pensylvanie*]. — Bostock, *Nicholson Journal of Natural Philosophy, Chemistry, and the Arts*, iv. 136. — Bigelow, *Am. Med. Bot.* iii. 32. — Moore, *Am. Jour. Sci.* ser. 2, xxxiii. 318. — Porcher, *Resources of Southern Fields and Forests*, 312. — Maisch, *Am. Jour. Pharm.* lvii. 339. — *U. S. Dispens.* ed. 16, 394. — Beringer, *Am. Jour. Pharm.* lxvi. 220.)

An account of the employment of the wax of Myrica for illuminating, and of his successful use of it in the treatment of dysentery, was sent to Paris by Monsieur Alexandre, a French physician living in Louisiana, and was published in *L'Histoire de l'Academie Royale des Sciences* for the year 1722, 11. See, also, an article on *Un Arbrisseau d'Amérique qui porte de la cire*, *Ibid.* 1825, p. 39.

In 1758 Lepage du Pratz published in his *Histoire de la Louisiane* (ii. 36) an account of Myrica wax, in which he declared that "Le cirier est un des plus grands biens dont la Nature ait enrichi la Louisiane, où les Abeilles s'établissent en terre, pour mettre leurs trésors à couvert des ravages des Ours qui en sont très friands, & qui craignent peu leurs piqûres." Efforts were made to manufacture the wax in France, where plantations of the two Atlantic coast species were made for the purpose with seeds sent by Michaux from the United States. They do not appear to have been successful; and as early as the middle of the last century the use of Myrica wax in candles had already greatly diminished in Pennsylvania, owing to the difficulty and expense of collecting the fruit, although its price was only about one half that of beeswax. (See Kalm, *Travels*, English ed. i. 192. See, also, W. Bartram, *Travels*, 406. — Romans, *Nat. Hist. Florida*, 188. — Descourtilz, *Voyages*, i. 269.)

In south Africa considerable attention was at one time paid to the manufacture of wax from the different indigenous species of Myrica, and to their cultivation for its production as well as to hold the shifting sands of the shore dunes in place. (See Pappe, *Sylva Capensis*, 40.)

[12] Willdenow, *Spec.* iv. pt. ii. 746 (1805). — Humboldt, Bonpland & Kunth, *l. c.* 19. — Kunth, *l. c.* 362. — C. de Candolle, *l. c.* 154. — Otto Kuntze, *Rev. Gen. Pl.* ii. 638.

Myrica macrocarpa, Humboldt, Bonpland & Kunth, *l. c.* 16 (1817). — Kunth, *l. c.* 361.

Myrica arguta, Humboldt, Bonpland & Kunth, *l. c.* 17, t. 98. — Kunth, *l. c.* 362. — C. de Candolle, *l. c.* 153.

Myrica Caracasana, Humboldt, Bonpland & Kunth, *l. c.* 18. — Kunth, *l. c.* — C. de Candolle, *l. c.* 154.

Myrica arguta, β *macrocarpa*, C. de Candolle, *l. c.* 153 (1864).

Myrica arguta, γ *tinctoria*, C. de Candolle, *l. c.* (1864).

Myrica arguta, δ *Peruviana*, C. de Candolle, *l. c.* (1864).

[13] Linnæus, *Spec.* 1025 (1753). — Willdenow, *l. c.* 748. — Thunberg, *l. c.* 158. — *Nouveau Duhamel*, ii. 193. — Pappe, *l. c.* — C. de Candolle, *l. c.* 148.

[14] The bark of Myrica is acrid, astringent, and stimulant, and in the United States that of *Myrica cerifera* and *Myrica Carolinensis* has been extensively used in domestic practice in the treatment of diarrhœa and by eclectics as an ingredient in the "Thompsonian Powder" (Barton, *Coll.* ii. 4. — Bigelow, *l. c.* 40. — Rafinesque, *Med. Fl.* ii. 244. — Humbright, *Am. Jour. Pharm.* xxxv. 193. — Johnson, *Man. Med. Bot. N. Am.* 250. — *U. S. Dispens.* ed. 16, 1864. — Beringer, *l. c.* 221). The bark of the root is employed in homœopathic practice (Lee, *Jour. Mat. Med.* n. ser. i. 257. — Hale, *Parthenogenesis of Myrica cerifera.* — Millspaugh, *Am. Med. Pl. in Homœopathic Remedies*, ii. 166, t. 160).

a stimulant, in tanning, and as a dye; and *Myrica sapida*,[1] which is distributed from the shores of southern Japan through southern China and Malaya to the subtropical western Himalaya, is often cultivated for its succulent aromatic scarlet fruit.

In North America Myrica is not known to be injured by insects, and is not liable to serious fungal diseases.[2]

The generic name, probably from *μυρίκη*, the ancient name of some shrub, possibly the Tamarisk,[3] was adopted for this genus by Linnæus, who discarded the older Gale of J. Bauhin.[4]

In India the bark of *Myrica sapida* is collected on the subtropical Himalayas and exported to the plains, where it is used in tanning leather, in dyeing, and in native practice for its heating and stimulating properties (Brandis, *Forest Fl. Brit. Ind.* 495. — Balfour, *Cyclopædia of India*, ed. 3, ii. 1029. — *Pharmacographia Indica*, iii. 355); in Japan an astringent pigment obtained from the bark is employed to color and preserve fish-nets (Rein, *Industries of Japan*, 177).

[1] Wallich, *Tent. Fl. Nepal.* 59, t. 45 (1824). — C. de Candolle, *Prodr.* xvi. pt. ii. 152. — Brandis, *l. c.* — Gamble, *Man. Indian Timbers*, 391.

Myrica Farquhariana, Wallich, *l. c.* 61 (1824). — C. de Candolle, *l. c.*

Myrica integrifolia, Roxburgh, *Fl. Ind.* ed. 2, iii. 765 (1832). — C. de Candolle, *l. c.* 151.

Myrica rubra, Siebold & Zuccarini, *Abhand. Akad. Münch.* iv. 230 (1846). — Bentham, *Fl. Hongk.* 322. — Franchet & Savatier, *Enum. Pl. Jap.* i. 454.

Myrica Nagi, C. de Candolle, *l. c.* (not Thunberg) (1864). — Kurz, *Forest Fl. Brit. Ind.* ii. 475. — Miquel, *Ann. Mus. Lugd. Bat.* iii. 129 (*Prol. Fl. Jap.*). — Hooker f. *Bot. Mag.* xciv. t. 5727; *Fl. Brit. Ind.* v. 597 (excl. syn. *Nageia Japonica*).

[2] Nearly thirty species of fungi are known to infest *Myrica Caroliniensis* and *Myrica cerifera* in North America, but they are neither conspicuous nor destructive. The small Cluster Cup, *Æcidium myricatum*, Schweinitz, is not uncommon at midsummer on the under side of the leaves, which are also attacked by species of Cercospora. The leaves of *Myrica Gale* are often blackened and curled by *Ramularia monilioides*, Ellis & Everhart. *Myrica peregrina* is attacked by a Rust, *Cronartium asclepiateum*, Fries, which forms scattered semigelatinous or waxy fibres on the under surface of the leaves. A similar form in Europe has as its cluster cup or æcidial stage a Peridermium which occurs on Pine-trees. A similar Peridermium is frequently found on the leaves of *Pinus rigida*, Miller, which is often associated with *Myrica peregrina*.

[3] It has been suggested that Myrica is from *μυρίζω*, in allusion to the fragrance of these plants; or from *μύρω*, to flow, as they often grow in the neighborhood of water.

[4] *Hist. Pl.* i. pt. ii. 224.

CONSPECTUS OF THE NORTH AMERICAN ARBORESCENT SPECIES.

MORELLA.

Flowers diœcious.

Leaves oblong-spatulate, usually acute or rarely rounded at the apex, mostly coarsely serrate above the middle, yellow-green, coated below with conspicuous orange-colored glands . . . 1. M. CERIFERA.

Leaves usually broadly oblong-obovate, rounded or rarely acute at the apex, entire, dark green and lustrous . . . . . 2. M. INODORA.

Flowers monœcious.

Leaves lanceolate-cuneate or oblong-lanceolate, sharply serrate, dark green and lustrous . . . 3. M. CALIFORNICA.

MYRICA CERIFERA.

Wax Myrtle.

LEAVES oblong-spatulate, usually acute or rarely rounded at the apex, mostly coarsely serrate above the middle, yellow-green, coated below with conspicuous orange-colored glands.

Myrica cerifera, Linnæus, *Spec.* 1024 (excl. var. β) (1753). — Miller, *Dict.* ed. 8, No. 2. — Muenchhausen, *Hausv.* v. 207. — Wangenheim, *Beschreib. Nordam. Holz.* 148; *Nordam. Holz.* 101. — Marshall, *Arbust. Am.* 94. — Moench, *Bäume Weiss.* 64; *Meth.* 362. — Burgsdorf, *Anleit. Anpfl.* 153. — Walter, *Fl. Car.* 242. — Willdenow, *Berl. Baumz.* 199; *Spec.* iv. pt. ii. 745; *Enum.* 1011. — Borkhausen, *Handb. Forstbot.* i. 527. — Persoon, *Syn.* ii. 614. — Desfontaines, *Hist. Arb.* ii. 472. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 404. — Pursh, *Fl. Am. Sept.* ii. 620. — Rafinesque, *Fl. Ludovic.* 116. — Nuttall, *Gen.* ii. 235; *Trans. Am. Phil. Soc.* n. ser. v. 167. — Hayne, *Dendr. Fl.* 197. — Elliott, *Sk.* ii. 678. — Poiret, *Lam. Dict. Ill.* iii. 402, t. 809. — Sprengel, *Syst.* i. 493. — Jaume St. Hilaire, *Traité des Arbres*, ii. t. 106. — Loudon, *Arb. Brit.* iv. 2057 (excl. var. *latifolia*). — Dietrich, *Syn.* i. 551. — Spach, *Hist. Vég.* xi. 263. — Chapman, *Fl.* 426 (excl. var. *media*). — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 106. — C. de Candolle, *Prodr.* xvi. pt. ii. 148 (in part). — K. Koch, *Dendr.* ii. pt. i. 663 (in part). — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 136 (in part); *Garden and Forest*, vii. 474, f. 75. — Lauche, *Deutsche Dendr.* ed. 2, 312. — Watson & Coulter, *Gray's Man.* ed. 6, 470 (in part). — Dippel, *Handb. Laubholzk.* ii. 313 (in part). — Koehne, *Deutsche Dendr.* 77 (in part). — Urban, *Bot. Jahrb.* xv. 357.

Myrica cerifera, β, Lamarck, *Dict.* ii. 592 (1786).

Myrica cerifera, α **angustifolia**, Aiton, *Hort. Kew.* iii. 396 (1789). — C. de Candolle, *Prodr.* xvi. pt. ii. 149.

Myrica cerifera, α **arborescens**, Castiglioni, *Viag. negli Stati Uniti*, ii. 302 (1790). — Michaux, *Fl. Bor.-Am.* ii. 228.

Lacistema Berterianum, Schultes, *Roemer & Schultes Syst. Mant.* i. 66 (1822).

Lacistema alternum, Sprengel, *Syst.* i. 124 (1825).

Myrica heterophylla, Rafinesque, *Alsograph. Am.* 9 (1838).

Cerophora lanceolata, Rafinesque, *Alsograph. Am.* 11 (1838).

Myrica Carolinensis, A. Richard, *Fl. Cub.* iii. 231 (not Miller) (1853).

Myrica microcarpa, Grisebach, *Fl. Brit. W. Ind.* 177 (in part) (not Bentham) (1864); *Cat. Pl. Cub.* 69. — C. de Candolle, *Prodr.* xvi. pt. ii. 149 (in part).

? Myrica microcarpa, β **angustifolia**, C. de Candolle, *Prodr.* xvi. pt. ii. 149 (1864).

Myrica altera, C. de Candolle, *Prodr.* xvi. pt. ii. 595 (1868).

A tree, occasionally forty feet in height, with a tall trunk eight or ten inches in diameter, and slender upright or slightly spreading branches which form a narrow round-topped head; generally smaller, frequently sending up from the ground numerous stems, and sometimes reduced to a shrub from four or five inches to two or three feet in height. The bark of the trunk is about a quarter of an inch thick, with a smooth close light gray surface. The branchlets are slender, and marked with small pale lenticels, and when they first appear are coated with loose rufous tomentum and caducous orange-colored glands; gradually losing their tomentum during the summer, they are bright red-brown or dark brown tinged with red or gray, usually lustrous, and nearly glabrous during their first winter, and then become dark brown. The leaf-buds are oblong, acute, from a sixteenth to an eighth of an inch long, and covered with numerous ovate acute loosely imbricated scales; in expanding their inner scales lengthen with the young branch, often becoming nearly half an inch long, and do not fall until it is nearly fully grown. The leaves are lanceolate-cuneate or oblong-lanceolate, acute or rarely gradually narrowed and rounded at the apex, cuneate at the base, decurrent on short stout petioles, and furnished above the middle with a few coarse teeth, or sometimes entire; when they unfold they are coated with bright orange-colored glands, and at maturity are thick and firm in texture, yellow-green, and covered above by minute dark glands, and below by bright orange-colored glands, from an inch

and a half to four inches long and from one quarter to one half of an inch wide, with somewhat thickened and revolute margins, slender pale midribs slightly raised and rounded on the upper side, and often puberulous below, few obscure arcuate veins, and reticulate veinlets; they are fragrant, with a balsamic resinous odor, and, beginning to fall after the appearance of the flowers of the following year, are gradually shed during the spring and early summer. The flower-buds, which are formed during the summer, are minute, nearly globose, and covered with closely imbricated tomentose scales, the staminate and pistillate being produced on different individuals. The flowers open in early spring, and are ebracteolate; they are borne in small oblong aments with ovate acute ciliate scales, those of the staminate plant being from one half to three quarters of an inch in length and about twice as long as those of the pistillate plant. The stamens are composed of oblong slightly obcordate anthers tinged at first with red, but soon becoming yellow, and slender filaments united below into an elongated stout-stemmed cluster about as long as the scale of the ament. The ovary is ovate, and gradually narrowed into two slender spreading stigmas longer than the scales of the flower. The fruit, which ripens in September and October, remains on the branches during the winter, and then falls irregularly in the spring and early summer; it is borne in short spikes, and is globose, usually rather less than an eighth of an inch in diameter, slightly papillose, light green, and coated with a thick pale blue waxy secretion; the shell of the nut is thick and bony, and the seed is minute and covered by a pale testa.

Myrica cerifera is distributed from southern Maryland[1] to southern Florida, through the Gulf states to the shores of Aransas Bay in Texas,[2] and northward in the region west of the Mississippi to the valley of the Washita River in Arkansas; it also occurs on the Bermuda[3] and Bahama Islands, San Domingo, Cuba, Guadaloupe, and Porto Rico.[4] On the south Atlantic and Gulf coasts *Myrica cerifera* grows to its largest size, and is very abundant, inhabiting sandy swamps and pond holes in company with the Red Maple, the Sweet Bay, the Black Gum, the Sweet Gum, the Titi, and other water-loving plants, and, in its arborescent form, rarely ranging more than forty or fifty miles from the sea. As a shrub[5] sometimes only a few inches in height, it grows near the coast on sandy Pine-barren soil, and in the interior on dry sandy arid hills in northern Alabama,[6] eastern Texas, northern Louisiana, and southern Arkansas.

The wood of *Myrica cerifera* is light, soft, and brittle, although close-grained; it is dark brown, with thin lighter colored sapwood, and contains numerous thin medullary rays. The specific gravity of the absolutely dry wood is 0.5637, a cubic foot weighing 35.13 pounds.

Myrica cerifera was first described in 1691 by Plukenet in the *Phytographia*.[7]

[1] *Myrica cerifera* was collected near Point Lookout on the shores of Cornfield Harbor, Maryland, in 1894, by Mr. Robert Ridgway.

[2] *Myrica cerifera* was collected near Rockport, on Aransas Bay, in 1893, by Mr. J. Reverchon.

[3] *Myrica cerifera* was collected in Bermuda by C. S. Sargent in May, 1891.

[4] Urban, *Bot. Jahrb.* xv. 358.

[5] *Myrica cerifera*, *γ pumila*, Michaux, *Fl. Bor.-Am.* ii. 228 (1803). — Pursh, *Fl. Am. Sept.* ii. 620. — Loudon, *Arb. Brit.* iv. 2058. — Chapman, *Fl.* 427.

Myrica cerifera, *β*, Willdenow, *Spec.* iv. pt. ii. 746 (not Linnæus) (1805).

Myrica sessilifolia, Rafinesque, *Alsograph. Am.* 10 (1838).

Myrica pusilla, Rafinesque, *l. c.* 10 (1838).

[6] *Teste* C. Mohr.

[7] *Myrtus, Brabanticæ similis, Caroliniensis baccata, fructu racemoso sessili monopyreno*, t. 48, f. 9; *Alm. Bot.* 260. — Catesby, *Nat. Hist. Car.* i. 69, t. 69.

Myrica foliis lanceolatis, fructu baccato, Linnæus, *Hort. Cliff.* 455; *Hort. Ups.* 295. — Clayton, *Fl. Virgin.* 120. — Royen, *Fl. Leyd. Prodr.* 527.

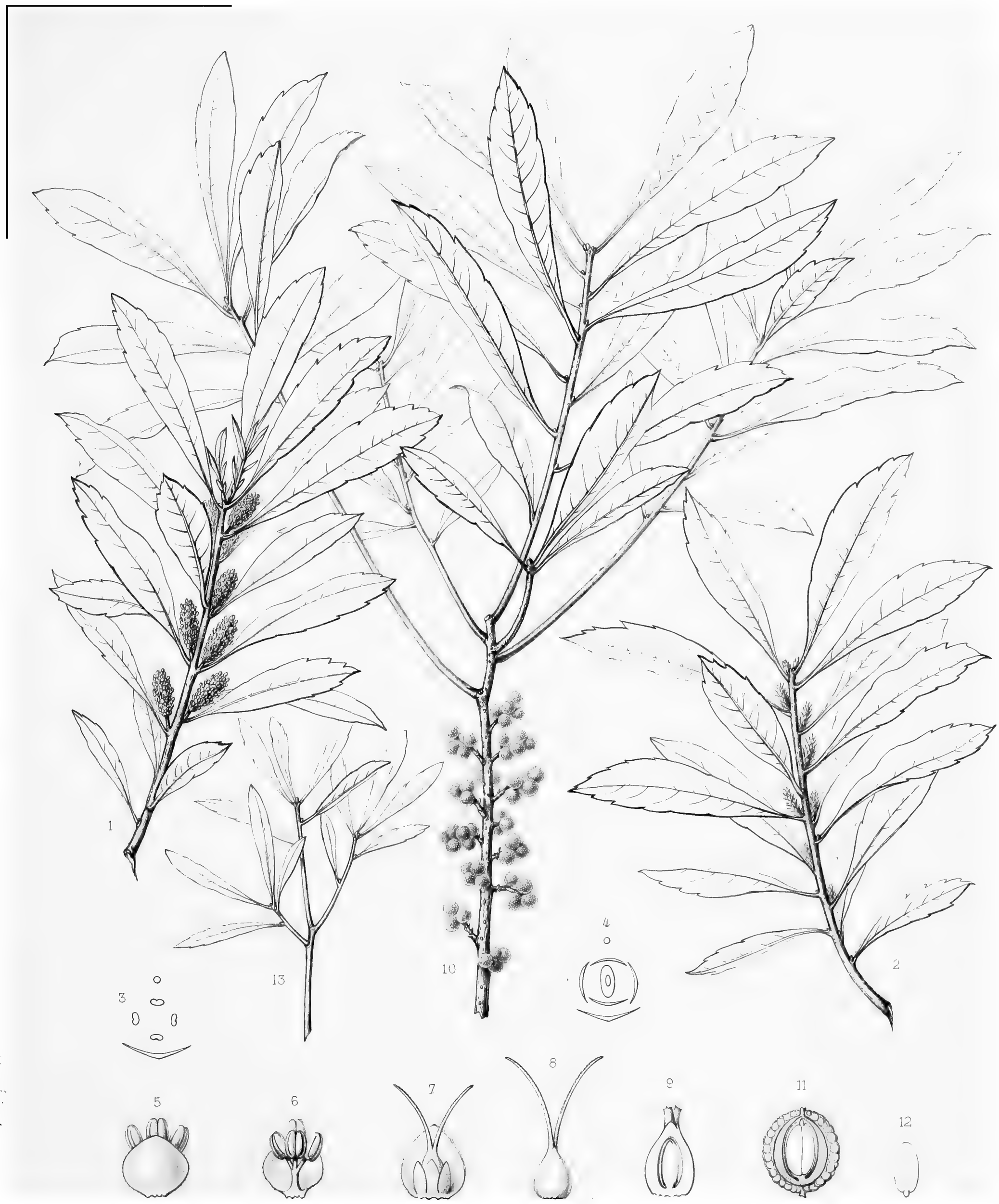
Gale Myrtus Brabanticæ similis Caroliniensis baccata fructu racemoso sessili Monopireno, Duhamel, *Traité des Arbres*, i. 254.

Myrica (seu) Myrtus (brabantica similis) floridana, baccifera, baccis sessilis; fructu cerifero, Romans, *Nat. Hist. Florida*, 28.

EXPLANATION OF THE PLATE.

Plate CCCCLIX. Myrica cerifera.

1. A flowering branch of the staminate tree, natural size.
2. A flowering branch of the pistillate tree, natural size.
3. Diagram of a staminate flower.
4. Diagram of a pistillate flower.
5. A staminate flower with its scale, rear view, enlarged.
6. A pistillate flower with its scale, front view, enlarged.
7. A pistillate flower with its scale, enlarged.
8. A pistillate flower, enlarged.
9. Vertical section of an ovary, enlarged.
10. A fruiting branch, natural size.
11. Vertical section of a fruit, enlarged.
12. An embryo, much magnified.
13. A sterile branch of the dwarf form.



C.E.Faxon del. *Migneaux sc.*

MYRICA CERIFERA, L.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*

MYRICA INODORA.

Wax Myrtle.

LEAVES usually broadly oblong-obovate, rounded or rarely acute at the apex, entire, coriaceous, dark green and lustrous.

Myrica inodora, W. Bartram, *Travels*, 405 (1791). — Chapman, *Fl.* 427.
Cerophora inodora, Rafinesque, *Alsograph. Am.* 11 (1838).
Myrica obovata, C. de Candolle, *Prodr.* xvi. pt. ii. 150 (1864).
? Myrica Laureola, C. de Candolle, *Prodr.* xvi. pt. ii. 154 (1864).

Usually a shrub, with numerous slender stems springing from the ground, *Myrica inodora* occasionally assumes the habit of a tree and attains the height of eighteen or twenty feet, forming a straight trunk six or eight feet tall, two or three inches in diameter, and covered with close thin smooth and nearly white bark. The branchlets are stout and roughened with small scattered lenticels, and at first are coated with dense pale tomentum which soon begins to disappear, and during their first summer and autumn they are bright red-brown and glabrous or scurfy, or often light brown, and sometimes slightly puberulous. The leaf-buds are ovate, acute, and nearly an eighth of an inch long, and are covered by many loosely imbricated lanceolate acute red-brown scurfy pubescent scales, those of the inner ranks often remaining on the young branch until it has finished the growth of the year. The leaves are broadly oblong-obovate or rarely ovate, rounded or sometimes pointed and occasionally apiculate at the apex, narrowed at the base, decurrent on the short stout petioles, and entire or rarely obscurely toothed toward the apex; when they unfold they are covered with pale glands, and when fully grown are thick and coriaceous, glandular-punctate, dark green and very lustrous above, bright green below, from two to four inches long and from three quarters of an inch to an inch and a half wide, with broad conspicuously glandular midribs often slightly puberulous on the lower side, and few remote slender obscure primary veins forked and arcuate near the much thickened and revolute margins; they have no resinous odor, and, beginning to fall in May, disappear from the branches before midsummer. The flower-buds are oblong or subglobose, about an eighth of an inch long, and covered with rather loosely imbricated ovate acute apiculate chestnut-brown scales. The flowers, which are usually ebracteolate, open in April or May and are borne in simple oblong catkins with ovate acute glandular scales, the staminate being from three quarters of an inch to an inch in length and about as long as the slender-stemmed elongated pistillate aments, which lengthen with the growing fruit and are often two inches long when it is ripe. The stamens are composed of oblong slightly emarginate yellow anthers and short filaments united at the base. The pistillate flowers, which are usually in pairs, consist of ovate glabrous ovaries terminating in slender bright red styles. The fruit, which is produced very sparingly,[1] is oblong, from one third to nearly one half of an inch long, papillose, black, and covered with a thin coat of white wax; the shell of the nut is thick and bony. The seed is oblong-oval, gradually narrowed and acute at the apex, rounded at the base, and an eighth of an inch in length, with a bright orange-brown testa and a conspicuous light yellow hilum.

Myrica inodora inhabits deep swamps; and has been found only near Appalachicola, Florida,

[1] The only mature fruit of this plant which I have seen is from a specimen collected by Drummond near Appalachicola in 1835 and preserved in the herbarium of the Royal Gardens at Kew, for which I am indebted to the director of that establishment.

Mobile, where it was discovered in 1778 by William Bartram,[1] and Stockton, Alabama, and in the valley of the Pearl River near Poplarville, Mississippi.[2]

The wood of *Myrica inodora* has not been examined.

[1] See i. 16.

[2] *Myrica inodora* was found near Stockton, Alabama, October 10, and near Poplarville, Mississippi, October 18, 1894, by Dr. Carl Mohr.

EXPLANATION OF THE PLATE.

Plate CCCCLX. Myrica inodora.

1. A flowering branch of the staminate tree, natural size.
2. A flowering branch of the pistillate tree, natural size.
3. A staminate flower with its scale, rear view, enlarged.
4. A staminate flower with its scale, front view, enlarged.
5. Pistillate flowers with their scale, front view, enlarged.
6. Vertical section of a pistillate flower, enlarged.
7. A fruiting branch, natural size.
8. Vertical section of a fruit, enlarged
9. A seed, enlarged.
10. An embryo, much magnified.

C.E.Faxon del. *Migneaux sc.*

MYRICA INODORA, W. Bartr.

A.Riocreux direx^t. *Imp. J.Taneur, Paris.*

MYRICA CALIFORNICA.

Wax Myrtle.

LEAVES lanceolate-cuneate or oblong-lanceolate, acute, sharply serrate, coriaceous, dark green and lustrous, puberulous on the lower surface.

Myrica Californica, Chamisso, *Linnæa*, vi. 535 (1831). — Bentham, *Pl. Hartweg.* 336; *Bot. Voy. Sulphur*, 55. — Hooker, *Fl. Bor.-Am.* ii. 160. — Hooker & Arnott, *Bot. Voy. Beechey*, 390. — Lindley, *Jour. Lond. Hort. Soc.* vii. 282, f. — Torrey, *Pacific R. R. Rep.* iv. pt. v. 137; *Bot. Wilkes Explor. Exped.* 465. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 89. — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 68. — C. de Candolle, *Prodr.* xvi. pt. ii. 153. — Hall, *Bot. Gazette*, ii. 93. — Brewer & Watson, *Bot. Cal.* ii. 81. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 137.

Gale Californica, Greene, *Man. Bot. Bay Region*, 298 (1894).

A tree, occasionally forty feet in height, with a trunk fourteen or fifteen inches in diameter, and short slender branches which form a narrow compact round-topped head; usually much smaller, and at the north and toward the southern limits of its range reduced to a low shrub often not more than three or four feet tall. The bark of the trunk is smooth, compact, from a sixteenth to an eighth of an inch in thickness, dark gray or light brown on the surface, and dark red-brown internally. The branchlets are stout, dark green, and coated with loose tomentum when they first appear, and dark green or light or dark red-brown and glabrous or pubescent during their first year; in their second year, when they are much roughened by the elevated leaf-scars, they grow darker, and ultimately become ashy gray. The leaf-buds are ovate, acute, about an eighth of an inch thick, and covered with loosely imbricated ovate acute dark red-brown tomentose scales which are persistent on the lengthening branchlet and when fully grown are often nearly half an inch long. The leaves are lanceolate-cuneate or oblong-lanceolate, acute, and remotely serrate with small incurved teeth except at the gradually narrowed base, which is decurrent on a short stout petiole; when they unfold they are covered with small white glands, and coated below with thick rusty tomentum which disappears at the end of a few days, and when fully grown they are thin and firm in texture, dark green and lustrous on the upper surface, and on the lower surface yellow-green, glabrous or puberulous, and marked with minute black glandular dots, from two to four inches long and from one half to three quarters of an inch wide, with narrow yellow midribs slightly impressed above, and numerous obscure primary veins arcuate near the thickened and revolute margins and connected by rather conspicuous reticulate cross veinlets; they are slightly fragrant, and fall gradually after the end of their first year. On vigorous sterile shoots lanceolate acute hairy caducous stipules nearly a quarter of an inch long occasionally occur. The flower-buds are subglobose, about an eighth of an inch long, and coated with hoary tomentum. The flowers, which are subtended by conspicuous bractlets, open from April in the south to June in the north, those of the two sexes being produced on the same individual, the staminate in oblong simple aments often an inch in length, and the pistillate in shorter aments in the axils of upper leaves, while androgynous aments often occur between the two with staminate flowers at their base and pistillate flowers above, or with the staminate flowers also mixed with the pistillate flowers at the apex;[1] the scales of the aments are ovate-acute, coated with pale tomentum and furnished with small ovate acute lateral bractlets. The stamens are fifteen or sixteen in number, and are composed of oblong slightly emarginate anthers, which are dark red-purple at first but soon become yellow, and slender filaments united into an elongated

[1] The usual arrangement of the flowers is with unisexual aments, the sterile below the fertile on the branch, but the occurrence of androgynous aments is not rare, and some individuals appear to produce exclusively or predominantly staminate flowers.

stout-stemmed cluster rather longer than the scale of the ament. The ovaries are ovate and gradually narrowed into two bright red exserted styles. The fruit, which is borne in short crowded spikes, ripens in the early autumn and usually falls during the winter; it is globose, papillose, dark purple, and covered with a thin coat of grayish white wax. The nut is thick-walled, and the testa of the seed is pale reddish brown.

Myrica Californica inhabits ocean sand-dunes and moist hillsides in the vicinity of the coast, and is distributed from the shores of Puget Sound to the neighborhood of Santa Monica, California. Discovered by Menzies,[1] the surgeon and naturalist of Vancouver, on the Oregon coast at the end of the last century, and later by David Douglas[2] on the shores of Puget Sound, it was first described by the German poet and botanist, Chamisso,[3] who found it on the shores of the Bay of San Francisco, where this species grows to its largest size and attains its greatest beauty.

The wood of *Myrica Californica*, although brittle, is heavy, very hard and strong, and close-grained; it is a light rose-color, with thick lighter colored sapwood, and contains numerous thin conspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.6703, a cubic foot weighing 41.77 pounds.

Myrica Californica is occasionally used in California to decorate gardens.[4]

[1] See ii. 90.

[2] See ii. 94.

[3] See ii. 39.

[4] Hybrids between this tree and the shrubby *Myrica Caroliniensis* have been raised at Santa Rosa, California, by Mr. Luther Burbank. (See Burbank, *New Creations in Fruits and Flowers*, June, 1894, 27, f.)

EXPLANATION OF THE PLATE.

Plate CCCCLXI. Myrica Californica.

1. A flowering branch, natural size.
2. A staminate flower with its scale and bractlets, front view, enlarged.
3. A staminate flower with its scale and bractlets, rear view, enlarged.
4. A pistillate flower with its scale and bractlets, front view, enlarged.
5. Vertical section of a pistillate flower, enlarged.
6. A fruiting branch, natural size.
7. Vertical section of a fruit, enlarged.
8. Cross section of a fruit, enlarged.
9. An embryo, much magnified.

C.E. Faxon del. *Migneaux sc.*

MYRICA CALIFORNICA, Cham.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

SALIX.

FLOWERS diœcious, solitary on the scales of erect or pendulous aments; perianth 0; disk glandular; stamens 2 or many; ovary one-celled; ovules numerous, ascending. Fruit a 2-valved capsule. Leaves often acute, penniveined, stipulate, deciduous.

Salix, Linnæus, *Gen.* 300 (1737). — Adanson, *Fam. Pl.* ii. 376. — A. L. de Jussieu, *Gen.* 408. — Endlicher, *Gen.* 290. — Meisner, *Gen.* 348. — Bentham & Hooker, *Gen.* iii. 411. — Baillon, *Hist. Pl.* ix. 252. — Pax, *Engler & Prantl Pflanzenfam.* iii. pt. i. 36.
Diplima, Rafinesque, *Alsograph. Am.* 13 (1838).
Vetrix, Rafinesque, *Alsograph. Am.* 13 (1838).
Argorips, Rafinesque, *Alsograph. Am.* 13 (1838).
Oisodix, Rafinesque, *Alsograph. Am.* 13 (1838).
Vimen, Rafinesque, *Alsograph. Am.* 13 (1838).
Usionis, Rafinesque, *Alsograph. Am.* 14 (1838).
Biggina, Rafinesque, *Alsograph. Am.* 14 (1838).
Nectopix, Rafinesque, *Alsograph. Am.* 14 (1838).
Ripselaxis, Rafinesque, *Alsograph. Am.* 14 (1838).
Nectusion, Rafinesque, *Alsograph. Am.* 14 (1838).
Urnectis, Rafinesque, *Alsograph. Am.* 14 (1838).
Sokolofia, Rafinesque, *Alsograph. Am.* 14 (1838).
Diamarips, Rafinesque, *Alsograph. Am.* 15 (1838).
Nectolis, Rafinesque, *Alsograph. Am.* 15 (1838).
Psatherips, Rafinesque, *Alsograph. Am.* 15 (1838).
Telesmia, Rafinesque, *Alsograph. Am.* 15 (1838).
Diplusion, Rafinesque, *Alsograph. Am.* 15 (1838).
Nestylix, Rafinesque, *Alsograph. Am.* 15 (1838).
Amerina, Rafinesque, *Alsograph. Am.* 15 (1838).
Ripsoctis, Rafinesque, *Alsograph. Am.* 15 (1838).
Pleiarina, Rafinesque, *Alsograph. Am.* 15 (1838).
Capræa, Opiz, *Seznam*, 25 (1852).
Gruenera, Opiz, *Seznam*, 48 (1852).
Knafia, Opiz, *Seznam*, 56 (1852).
Lusekia, Opiz, *Seznam*, 61 (1852).

Trees or shrubs, with watery juice, scaly bitter bark, soft usually light-colored wood, slender terete tough branches easily separable at the joints, and fibrous often stoloniferous roots. Buds[1] sessile, appressed, acute or obtuse, covered by a single scale of two coats, the inner membranaceous, stipular and rarely separable from the outer, inclosing at its base two minute opposite lateral buds alternate with two small scale-like caducous opposite leaves coated with long pale or rufous hairs.[2] Leaves variously folded in the bud, alternate except the first pair, simple, lanceolate, obovate, rotund or linear, entire, serrate or rarely dentate or subspinulose, their teeth often glandular, penniveined, petiolate with subterete short or elongated petioles, sometimes glandular at the apex and more or less covering the bud by their enlarged bases, turning yellow or falling with little change of color in the autumn, or persisting during the winter and leaving U-shaped or arcuate elevated leaf-scars displaying the ends of three small equidistant fibro-vascular bundles. Stipules oblique, usually serrate, small and deciduous, or foliaceous and often persistent, generally large and conspicuous on vigorous young branches, leaving, when they fall, minute persistent scars. Flowers diœcious,[3] often fragrant, appearing before or with the unfolding of

[1] Salix does not form a terminal bud, the end of the branch dying during the summer or autumn, and leaving a minute scar close to the upper axillary bud, which prolongs the branch the following season. (See Ohlert, *Linnæa*, xi. 640 [*Knosp. Bäume und Sträucher*]).

[2] According to Henry (*Nov. Act. Cæs. Leop.* xxii. 329, t. 31), who appears to have overlooked the fact that the bud-scale of *Salix cordata*, Muehlenberg, separates readily into two coats, the bud-covering of Salix consists of the union of two opposite connate leaves bearing in their axils the two rudimentary buds, while Lindley (*Introduction to Botany*, ed. 3, 144) considers that the minute opposite buds under the scale of the bud of Salix help to confirm his view that stipules were only modified leaves.

[3] Androgynous aments in Salix are not rare, and occasionally staminate and pistillate aments are found on the same plant. (See Linnæus, *Spec. Pl.* 1015 [*Salix hermaphroditica*]. — Willdenow, *Spec.* iv. pt. ii. 654 [*Salix Hoppeana*]. — Host, *Salix*, 13, t. 46 [*Salix mirabilis*]; 22, t. 73 [*Salix montana*]. — Loudon, *Arb. Brit.* iii. 1454. — J. G. Jack, *Garden and Forest*, vii. 163.)

the leaves in sessile or pedunculate elongated and narrowly cylindrical or short and oblong-cylindrical or broad aments on lateral or terminal leafy branches of the year, the leaves sometimes reduced to small persistent or deciduous bracts; rachis of the ament usually terete, pilose with cinereous or pale hairs, or rarely glabrous; scales one-flowered, lanceolate, ligulate, concave, rotund or obovate, entire or rarely glandular-dentate at the apex, yellow, fulvous, or rose-colored, or yellow-green below and purple above, pilose on the back or only at the apex, strigose, villous, or ciliate, deciduous or persistent. Disk of the flower nectariferous, composed of an anterior and posterior or of a single posterior gland-like body, or glanduliform, erect, oblong or broadly obtuse or retuse. Stamens from three to twelve, or two, inserted on the base of the scale; filaments filiform, free or rarely united, usually light yellow, glabrous or hairy toward the base; anthers small, ovate or oblong, attached on the back near the bottom, introrse, generally rose-colored before anthesis and orange or purple at maturity, two-celled, the cells lateral, opening longitudinally. Ovary sessile or stipitate, conical and obtuse, or subulate-rostrate, glabrous, tomentose, or villous; style abbreviated, divided into two short recurved retuse or two-parted stigmatic branches; ovules short-stalked, from four to eight on each of the two parietal placentas, inserted near their base, ascending, anatropous, the micropyle inferior. Capsule usually acuminate, one-celled, separating at maturity into two recurved valves, placentiferous below the middle. Seed exalbuminous, minute, narrowed at both ends, surrounded by a tuft of long pale soft hairs attached to the short funiculus and deciduous with it; testa membranaceous, dark chestnut-brown or nearly black. Embryo straight, filling the cavity of the seed; cotyledons equal, oblong, plano-convex, much longer than the short radicle turned toward the minute basal hilum.[1]

[1] By Andersson (*Svensk. Vetensk. Akad. Handl.* ser. 4, vi. No. 1 [*Monographia Salicum*]; *De Candolle Prodr.* xvi. pt. ii. 192) the species of Salix are grouped in the following tribes and sections:

A. PLEIANDRÆ. Scales of the ament pale, one-colored, caducous. Stamens three or many.

Sec. 1. *Tetraspermæ.* Aments few-flowered. Capsules ovate, subangular. Leaves broad at the base, sharply serrate, rigid, lustrous. Trees, inhabitants of tropical and subtropical regions.

Sec. 2 *Acmophyllæ.* Aments densely flowered. Capsules ovate-conical, thick, short-stalked. Leaves elongated, narrowly lanceolate, entire or subentire, glaucous below. Trees, inhabitants of western Asia.

Sec. 3. *Octandræ.* Aments densely flowered, abbreviated. Capsules subglobose. Leaves lanceolate, cuspidate, glaucous below. Trees and tall shrubs, inhabitants of northern and tropical regions, and of southern Africa, and Madagascar.

Sec. 4. *Humboldtianæ.* Aments elongated, rather sparsely flowered. Capsules conical, subrostrate. Leaves linear-lanceolate, often more or less falcate, finely serrate, usually one-colored on both surfaces. Trees and tall shrubs, inhabitants of tropical and subtropical America.

Sec. 5. *Amygdalinæ* (Koch, *Sal. Europ. Comm.* 17. — Kerner, *Verhandl. Zoöl.-Bot. Gesell. Wien*, x. 46 [*Niederösterr. Weiden*]). Aments pedunculate on leafy branches. Capsules narrow, long-stalked. Leaves linear-lanceolate, acuminate, usually glaucous below. Trees or tall shrubs, inhabitants of the northern hemisphere.

Sec. 6. *Pentandræ.* Aments pedunculate on leafy branches, their scales deciduous before the ripening of the fruit. Capsules more or less stalked. Leaves often long-cuspidate, sharply glandular-serrate, lustrous. Trees or shrubs, inhabitants of temperate regions in the northern hemisphere.

Sec. 7. *Fragiles.* Aments pedunculate on leafy branches, their scales one-colored, caducous. Capsules subsessile or rarely stalked. Leaves lanceolate, long and often obliquely pointed, glaucous below. Trees, inhabitants of temperate and boreal regions in the Old World.

B. DIANDRÆ. Scales of the ament two-colored, persistent. Stamens two, free or slightly united.

Sec. 8. *Longifoliæ.* Aments pedunculate on leafy branches. Capsules obtuse, usually short-stalked. Leaves lanceolate. Trees or shrubs, inhabitants of temperate and tropical regions in the New World.

Sec. 9. *Capreæ.* Aments precocious, sessile, usually leafless. Capsules conical, obtuse, long-stalked. Leaves usually oval or obovate, sharply and obliquely acuminate. Small trees, large shrubs, or undershrubs, inhabitants of both hemispheres.

Sec. 10. *Roseæ.* Aments pedunculate on leafy branches. Capsules usually long-stalked and glabrous. Leaves thin, elliptical or lanceolate, rosy while young, usually glaucescent at maturity. Low shrubs, inhabitants of boreal regions.

Sec. 11. *Argenteæ* (Koch, *l. c.* 46 [*Incubaceæ*, Fries, *Nov. Fl. Suec. Mant.* i. 64. — Kerner, *l. c.* 54]). Aments subsessile. Capsules more or less stalked. Leaves linear-lanceolate, elongated, usually silvery tomentose below. Shrubs, mostly small, inhabitants of temperate and boreal regions of the northern hemisphere.

Sec. 12. *Phylicifoliæ* (Fries, *l. c.* 48). Aments oval-cylindrical, subsessile. Capsules more or less stalked, usually silky. Leaves subobovate or ovate-lanceolate, glaucous below. Shrubs, usually tall, inhabitants of boreal, alpine, and arctic regions.

Sec. 13. *Rigidæ.* Aments more or less coetaneous with the appearance of the leaves, their scales yellow, and darker and bearded at the apex. Leaves elliptical or lanceolate, usually short-pointed, sharply serrate, pale on the lower surface. Trees and large and small shrubs, inhabitants of temperate and boreal regions of the northern hemisphere.

Sec. 14. *Pruinosæ* (Koch, *l. c.* 22. — Kerner, *l. c.* 51). Aments

Salix, of which from one hundred and sixty to one hundred and seventy species are now distinguished,[1] inhabits the banks of streams and low moist ground, the alpine summits of mountains, and the arctic and subarctic regions of the northern hemisphere, ranging southward in the New World with a few species through the West Indies[2] and Central America[3] to the Andes of Chili, the home of one species,[4]

thick and cylindrical, sessile, their scales golden or cinereous-villous. Capsules sessile, usually glabrous. Leaves elongated, lanceolate, usually glaucous below and glabrous. Trees or shrubs, inhabitants of temperate regions in western North America, Europe, and Asia.

Sec. 15. *Viminales* (Koch, *Sal. Europ. Comm.* 27. — Kerner, *Verhandl. Zoöl.-Bot. Gesell. Wien*, 48 [*Niederösterr. Weiden*]). Aments elongated, cylindrical, densely flowered. Capsules conical, usually tomentose. Leaves elongated, lanceolate, their margins usually revolute, entire or dentate. Trees or tall shrubs, inhabitants of Europe, and of northern and subtropical Asia.

Sec. 16. *Niveæ* (*Chrysanthæ*, Koch, *l. c.* 52. — *Chrysanthos*, Fries, *Nov. Fl. Suec. Mant.* i. 45). Aments subterminal, sessile, densely flowered. Capsules conical, rostrate, usually glabrous. Leaves subrotund or broadly lanceolate, conspicuously reticulate-verrucose below. Shrubs, often tall, inhabitants of boreal and arctic regions in both hemispheres.

Sec. 17. *Nitidulæ*. Aments terminal, generally on two-leaved branches of the year. Capsules usually subsessile. Leaves generally rigid and coriaceous. Shrubs, often prostrate, inhabitants of arctic and alpine regions of the northern hemisphere.

C. SYNANDRÆ. Scales of the ament two-colored. Stamens two, their filaments connate.

Sec. 18. *Incanæ* (*Canæ*, Kerner, *l. c.* 49). Aments sessile, narrowly cylindrical, erect, their scales obtuse, yellow. Capsules stalked. Leaves lanceolate, coated below with silvery tomentum. Shrubs, inhabitants of the Old World.

Sec. 19. *Purpureæ* (Koch, *l. c.* 24). Aments narrowly cylindrical, their scales obtuse. Capsules sessile, silky. Leaves linear-lanceolate, elongated, glaucescent. Shrubs, inhabitants of the Old World.

[1] Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 1 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 191.

In Europe, where the genus has been most carefully studied, many forms believed to be hybrids have been described (see Wesmael, *Bull. Soc. Bot. Belg.* iii. No. 1; *Flore Forestière de Belgique*, 135; Wimmer, *Salices Europaeæ*, 131; White, *Jour. Linn. Soc.* xxvii. 340 [*Rev. Brit. Willows*]); and in the United States a few hybrids have also been observed.

Professor William R. Dudley (*Bull. Cornell University*, ii. 90 [*Cayuga Flora*, 1886]) describes a Willow found by him in 1884 in the neighborhood of Cayuga Lake, New York, as *Salix cordata* × *incana*, and believes it to be a hybrid between the North American *Salix cordata*, Muehlenberg, and the European *Salix incana*, Schrank, a species occasionally cultivated in that region; and also a second hybrid (*Salix cordata* × *petiolaris*) from West Danby valley in the same region.

In 1885 Mr. Edwin Faxon distinguished in Tuckerman's Ravine on the slope of Mt. Washington, in New Hampshire, a hybrid between the shrubby *Salix argyrocarpa*, Andersson, and *Salix phylicifolia*, Linnæus (*Salix argyrocarpa* × *phylicifolia*, Bebb, *Bull. Torrey Bot. Club*, xvii. 149 [1890]). This plant, which was first collected in leaf only by Asa Gray in 1842, seems like a vigorous *Salix argyrocarpa* with the aments of *Salix phylicifolia*.

Dr. N. M. Glatfelter has found in the neighborhood of St. Louis, Missouri, a number of trees which display, in different degrees of intermixture, the characters of *Salix nigra*, Muehlenberg, and *Salix amygdaloides*, Andersson, and are evidently hybrids between these species (*Salix nigra* × *amygdaloides*, Glatfelter, *Trans. Acad. Sci. St. Louis*, vi. 427. — Bebb, *Garden and Forest*, viii. 363).

An arborescent Willow, probably first noticed by Mr. S. T. Olney near Providence, Rhode Island, and subsequently found by Professor H. G. Jesup at Amherst, Massachusetts, by Mr. J. A. Allen near Westville, Connecticut, and by Professor William R. Dudley at Newark, Wayne County, New York, displays some of the characters of *Salix alba*, Linnæus, and *Salix lucida*, Muehlenberg, and is believed to be a hybrid between these species (*Salix alba* × *lucida*, Bebb, *l. c.* 423, f. 57 [1895]. *Salix alba*, subspec. *Pameachiana*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* 48 (not *Salix Pameachiana*, Barratt [1867]); *De Candolle Prodr. l. c.* 212).

Six trees, of which two have been destroyed, found near Newark, Wayne County, New York, by Mr. E. L. Hankenson, with the leaves of *Salix nigra*, Marshall, and the aments of *Salix alba*, Linnæus, are believed to have been produced by a cross between these species (*Salix nigra* × *alba*, Bebb, *l. c.* f. 58 [1895]).

Hybrids between *Salix cordata*, Muehlenberg, and *Salix sericea*, Marshall, are not uncommon from Pennsylvania to Michigan (*Salix cordata* × *sericea*, Bebb, *Herb. Sal.* Nos. 12–17. — Dudley, *l. c.* *Salix myricoides*, Muehlenberg, *Neue Schrift. Gesell. Nat. Fr. Berlin*, iv. 235, t. 36, f. 2 [1803]. *Salix cordata*, var. *myricoides*, Darlington, *Fl. Cestr.* ed. 3, 278 (not Carey) [1853]).

Hybrids between *Salix cordata*, Muehlenberg, and *Salix candida*, Willdenow (*Salix cordata* × *candida*, Bebb, *Herb. Sal.* No. 34), and between *Salix petiolaris*, Smith, and *Salix candida*, Willdenow (*Salix petiolaris* × *candida*, Bebb, *Herb. Sal.* No. 30), were first distinguished in 1872 in a swamp near Flint, Michigan, by Dr. Daniel Clarke.

Dr. C. L. Anderson (*Zoë*, i. 41 [1890]) describes a Willow with androgynous aments found by him at Santa Cruz, California, which he considered a hybrid between *Salix Babylonica*, Linnæus, a common cultivated tree in the neighborhood, and the indigenous *Salix lasiandra*, Bentham.

[2] Grisebach, *Fl. Brit. W. Ind.* 112.

[3] Humboldt, Bonpland & Kunth, *Nov. Gen. et Spec.* ii. 22. — Kunth, *Syn. Pl. Æquin.* i. 364. — Hemsley, *Bot. Biol. Am. Cent.* iii. 179.

[4] *Salix Humboldtiana*, Willdenow, *Spec.* iv. pt. ii. 657 (1805). — Humboldt, Bonpland & Kunth, *l. c.* t. 99, 100. — Kunth, *l. c.* — Forbes, *Salict. Woburn.* 15, t. — Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 614. — Leybold, *Martius Fl. Brasil.* iv. pt. i. 227, t. 71. — Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* 16, t. 1, f. 13; *De Candolle Prodr. l. c.* 199. — Hemsley, *l. c.*

Salix falcata, Humboldt, Bonpland & Kunth, *l. c.* (not Muehlenberg) (1817). — Kunth, *l. c.* 365. — Trautvetter, *l. c.* 613.

Salix oxyphylla, Humboldt, Bonpland & Kunth, *l. c.* (1817). — Kunth, *l. c.* — Trautvetter, *l. c.* 616.

Salix Magellanica, Poiret, *Lam. Dict.* Suppl. v. 66 (1817).

Salix Martiana, Leybold, *l. c.* t. 72 (1855).

Salix Humboldtiana, subspec. *Martiana*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* 16 (1867); *De Candolle Prodr. l. c.* 199.

and in the Old World to Madagascar,[1] to southern Africa where one species[2] has been found, to the subtropical Himalayas of Sikkim[3] and Burmah,[4] and to the islands of Java and Sumatra.[5] Salix abounds in North America, especially at the north, where from sixty to seventy species occur,[6] twenty of which attain the size and habit of trees, while the others are large or small and sometimes prostrate shrubs, and in Europe,[7] in western and northern continental Asia,[8] and in Japan.[9] Impressions of the leaves of Salix found in the cretaceous rocks of Nebraska and of northern Europe show the antiquity of the genus, which is probably one of the oldest forms of dicotyledonous Angiospermæ,[10] and in North America and Europe achieved its greatest specific development during the miocene period.[11]

Salix produces soft tough light or rarely dark red-brown heartwood and pale often white sapwood used for many domestic purposes and for charcoal, the European and Asiatic *Salix alba*,[12] *Salix*

Salix Humboldtiana, subspec. *falcata*, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 17 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 199.

Salix Humboldtiana, subspec. *oxyphylla*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* (1867); *De Candolle Prodr. l. c.*

In Chili a manna-like secretion was at one time obtained in large quantities from this tree, and the bark was used as a febrifuge. (See Molina, *Saggio sulla storia naturale de Chile*, 140.)

[1] *Salix Madagascariensis*, Andersson, *Svensk. Ventensk. Akad. Handl. l. c.* 15, t. 1, f. 12 (1867); *De Candolle, Prodr. l. c.* 198.

Salix australis, Fries, *Nov. Fl. Suec. Mant.* i. 77 (not Forbes) (1832). — Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 622.

[2] *Salix mucronata*, Thunberg, *Prodr. Pl. Cap.* 6 (1794); *Fl. Cap.* 140. — Willdenow, *Spec.* iv. pt. ii. 685. — Fries, *l. c.* 76.

Salix Ægyptiaca, Thunberg, *Prodr. Pl. Cap.* 6 (not Linnæus) (1794).

Salix hirsuta, Thunberg, *l. c.* (1794); *Fl. Cap.* 141. — Willdenow, *l. c.* 695. — Trautvetter, *l. c.* 623. — Fries, *l. c.* 77.

Salix Capensis, Thunberg, *Fl. Cap.* 139 (1807). — Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* 13, t. 1, f. 11; *De Candolle Prodr. l. c.* 197.

Salix Gariepina, Burchell, *Travels*, i. 317 (1822). — Pappe, *Sylva Capensis*, 30.

[3] Andersson, *Svensk. Vetensk. Akad. Handl.* 1850, 463 (*Öst. Ind. Pilarter*); *Jour. Linn. Soc.* iv. 39. — Brandis, *Forest Fl. Brit. Ind.* 461. — Hooker f. *Fl. Brit. Ind.* v. 626.

[4] Kurz, *Fl. Brit. Burm.* ii. 493.

[5] Miquel, *Fl. Ind. Bat.* i. pt. ii. 460; Suppl. 187, 474; *Ill. Fl. Arch. Ind.* 11.

[6] Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 109 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 50.

[7] G. F. Hoffmann, *Hist. Sal.* — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 282. — Wahlenberg, *Fl. Lapp.* 257. — Seringe, *Saules de la Suisse.* — Koch, *Sal. Europ. Comm.* — Host, *Salix.* — Ledebour, *Fl. Ross.* iii. 596. — Smith, *English Flora*, iv. 163. — M. Sadler, *Syn. Sal. Hungar.* — Andersson, *Salices Lapponiæ.* — Kerner, *Verhandl. Zoöl.-Bot. Gesell. Wien.* x. 3 (*Niederösterr. Weiden*). — Wimmer, *Salices Europaeæ.* — Gandoger, *Sal. Nov.*

[8] Turczaninow, *Fl. Baicalensi-Dahurica*, ii. 97. — Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 242 (*Prim. Fl. Amur.*). — Regel, *Mém. Acad. Sci. St. Pétersbourg*, iv. 131 (*Tent. Fl. Ussur.*). — Boissier, *Fl. Orient.* iv. 1181. — Franchet, *Ann. Sci. Nat.* sér. 6, xviii. 251 (*Pl. Turkestan*); *Nouv. Arch. Mus.* v. 282; viii. 120 (*Pl. David.* i., ii.).

In southern China one indigenous Willow growing on the banks of streams in the neighborhood of Canton has been described (*Salix Cantoniensis*, Hance, *Jour. Bot.* vi. 48 [1868]).

[9] Thunberg, *Fl. Jap.* 24. — Blume, *Bijdr. Fl. Ned. Ind.* 516. — Andersson, *Mem. Am. Acad.* n. ser. vi. 450. — Miquel, *Ann. Mus. Lugd. Bat.* iii. 24 (*Prol. Fl. Jap.*).

[10] Schimper, *Pal. Vég.* ii. 663.

[11] Lesquereux, *Rep. U. S. Geolog. Surv.* vii. 165, t. 22, f. 1–7; viii. 41, t. 1, f. 14–16; t. 16, f. 3; 156, t. 31, f. 1–3; 247, t. 55, f. 2, 6, 7 (*Contrib. Fossil Fl. W. Territories*, ii., iii.). — Saporta, *Origine Paléontologique des Arbres*, 189. — Zittel, *Handb. Palæontolog.* ii. 462.

[12] Linnæus, *Spec.* 1021 (1753). — G. F. Hoffmann, *l. c.* 41, t. 7, 8. — Willdenow, *l. c.* 710. — Host, *l. c.* 9, t. 32, 33. — Forbes, *Salict. Woburn.* 271, t. — Ledebour, *Fl. Alt.* iv. 255; *Fl. Ross.* iii. 599. — Reichenbach, *Icon. Fl. German.* xi. 28, t. 608. — Hartig, *Forst. Culturpfl. Deutschl.* 420, t. 40. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 226. — Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* 47; *De Candolle Prodr. l. c.* 211. — Parlatore, *Fl. Ital.* iv. 217. — Boissier, *Fl. Orient.* iv. 1185. — Watson & Coulter, *Gray's Man.* ed. 6, 481.

Salix flexibilis, Gilibert, *Exercit.* ii. 406 (1792).

Salix pallida, Salisbury, *Prodr.* 394 (1796).

Salix heterophylla, Bray, *Denkschr. Bot. Gesell. Regensb.* i. 51 (1815).

Salix splendens, Opiz, *Böhm. Gewäch.* 110 (1823).

Salix alba, which is a noble tree often eighty feet in height, with a trunk frequently three or four feet in diameter, and ascending branches, is widely distributed in many forms through Europe from southern Scandinavia to the shores of the Mediterranean, and through Siberia, western Asia, and northern Africa, and is often cultivated as a timber and ornamental tree. It must have been brought to eastern North America soon after the settlement of the country by Europeans, as it is everywhere naturalized in all the coast region from the valley of the St. Lawrence River to that of the Potomac, growing on the banks of streams and on low ground to its largest size, the varieties *cærulea* (Andersson, *De Candolle Prodr. l. c.* 211 [1868]. *Salix alba*, β, Koch, *l. c.* 16 [1828]. *Salix cærulea*, Smith & Sowerby, *English Bot.* xxxiv. t. 2431 [1812]), with olive-green branchlets and dull bluish green leaves glaucous below, and *vitellina* (Willkomm & Lange, *l. c.* [1861]. *Salix alba*, γ, Koch, *l. c.* [1828]. *Salix vitellina*, Linnæus, *l. c.* 1016 [1753]), with yellow or reddish branchlets, being more common in North America than the typical form with greenish branchlets and silvery white silky leaves. In the treeless prairie and mid-continental plateau regions of North America, where the varieties of *Salix alba* have been planted in large numbers, they grow under the most severe climatic conditions more rapidly than other trees, often flourishing in positions where these have been unable to live.

The wood of *Salix alba* and of the other arborescent species is employed for the rafters of buildings, for the lining of carts used

fragilis,[1] and *Salix daphnoides*[2] being the most valuable timber-trees of the genus. The flexible tough branches of several species of Salix are employed in the manufacture of baskets, and some of them, especially the European and north Asian *Salix viminalis*[3] and *Salix purpurea*,[4] are largely

in the transportation of stone, in turnery and cooperage, and as charcoal in the manufacture of gunpowder. The strong vigorous shoots of pollarded trees are used for hoop-poles and stakes, and in the making of coarse baskets ; and in several of the provinces of European Russia plantations of *Salix alba* are carefully made to produce the strong vigorous stems used in the manufacture of the shaft-bows of Russian carriages. (See *Industries of Russia*, iii. 336.) The wood is preferred to all other woods for cricket-bats. The leaves afford excellent forage for domestic animals, and the bark is employed in tanning leather and in medicine. (See Loudon, *Arb. Brit.* iii. 1458.)

[1] Linnæus, *Spec.* 1017 (1753). — Willdenow, *Spec.* iv. pt. ii. 669. — Host, *Salix*, 5, t. 18, 19. — Forbes, *Salict. Woburn.* 53, t. — Reichenbach, *Icon. Fl. German.* xi. 28, t. 609. — Ledebour, *Fl. Ross.* iii. 598. — Hartig, *Forst. Culturpfl. Deutschl.* 419, t. 42. — Willkomm & Lange, *Prodr. Fl. Hispan.* 226. — Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 41 (*Monographia Salicum*) ; *De Candolle Prodr.* xvi. pt. ii. 209. — Parlatore, *Fl. Ital.* iv. 220. — Boissier, *Fl. Orient.* iv. 1184. — Watson & Coulter, *Gray's Man.* ed. 6, 481.

Salix decipiens, G. F. Hoffmann, *Hist. Sal.* ii. 9, t. 31 (1791).

Salix persicifolia, Schleicher, *Cat. Pl. Helv.* ed. 2, 30 (1807).

Salix Wargiana, Lejeune, *Fl. Spa*, ii. 322 (1813).

Salix fragilior, Host, *l. c.* 6, t. 20, 21 (1828).

Salix Monspeliensis, Forbes, *l. c.* 59, t. (1829).

Salix excelsa, Koch, *Syn. Fl. German.* i. 643 (1837).

Salix fragillima, Schur, *Enum. Pl. Transs.* 616 (1866).

Salix fragilis is widely distributed over Europe and western Asia, and is frequently cultivated for its reddish wood, which is considered more durable than that of the other European Willows. It is naturalized in eastern America, and, although less abundant here than *Salix alba*, it is the common arborescent Willow of the maritime provinces of Canada, where it grows to a large size, and of southern Pennsylvania, and Delaware, where it is cultivated as a pollard to produce charcoal for the important gunpowder works at Wilmington. From this tree a saccharine exudation is said to be obtained in Persia (Flückiger & Hanbury, *Pharmacographia*, 373).

Salix Russelliana, Smith (*Fl. Brit.* iii. 1045 [1804]. — Smith & Sowerby, *English Bot.* xxvi. t. 1809. — Forbes, *l. c.* 55, t. 28. — Reichenbach, *l. c.* t. 610), the Bedford Willow, which is considered by some authors a variety of *Salix fragilis* and by others a hybrid between this species and *Salix alba* (Wimmer, *Sal. Europ.* 133), is a large tree not infrequently found in low grounds in central and western Europe, where it is often planted for the sake of its timber or to produce poles (Loudon, *l. c.* 1517).

[2] Villars, *Hist. Pl. Dauph.* iii. 765 (1789). — Ledebour, *l. c.* 602. — Reichenbach, *l. c.* 26, t. 602. — Hartig, *l. c.* 416, t. 43. — Parlatore, *l. c.* 232. — Andersson, *De Candolle Prodr. l. c.* 261. — Brandis, *Forest Fl. Brit. Ind.* 469, t. 62. — Boissier *l. c.* 1191. — Hooker f. *Fl. Brit. Ind.* v. 631.

Salix bigemmis, Hoffmann, *Deutsche Fl.* ed. 2, 260 (1804).

Salix cinerea, Smith, *l. c.* 1063 (not Linnæus) (1804). — Host, *Salix*, 8, t. 26, 27. — Forbes, *l. c.* 249, t.

Salix præcox, Willdenow, *l. c.* 670 (1805). — Seringe, *Saules de la Suisse*, 55. — Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 242 (*Prim. Fl. Amur.*).

Salix Pomeranica, Forbes, *l. c.* 281, t. (1829). — Reichenbach, *l. c.* t. 26, 602.

Salix Reuteri, Moritzi, *Fl. Schweiz*, 459 (1844).

Salix daphnoides, which is often shrubby in habit, but in India sometimes becomes a tree sixty feet high with a tall straight trunk three or four feet in diameter, is a common inhabitant of the mountain regions of central Europe and of northern Germany, southern Scandinavia, northern Russia, Siberia, and Manchuria ; it is also common in the arid regions of the inner Himalayas, which it sometimes ascends to elevations of five thousand feet. In northern Europe *Salix daphnoides* has been successfully used to hold the soil on railway embankments and to fix shifting sands, its stout far-spreading roots making it especially valuable for this purpose. It is often cultivated in northwestern India to supply fodder for cattle, the branches are used for fencing, baskets, and bridge ropes, and the wood is employed in construction and in cooperage, and for the handles of tools (Gamble, *Man. Indian Timbers*, 377).

[3] Linnæus, *l. c.* 1021 (1753). — G. F. Hoffmann, *l. c.* 22, t, 2, f. 1, 2 ; t. 5, f. 2. — Willdenow, *l. c.* 706. — Host, *l. c.* 16, t. 54, 55. — Forbes, *l. c.* 265, t. — Ledebour, *Fl. Alt.* iv. 265 ; *Fl. Ross.* iii. 605. — Reichenbach, *l. c.* 25, t. 597. — Hartig, *l. c.* 398, t. 46. — Willkomm & Lange, *l. c.* 228. — Maximowicz, *l. c.* 243. — Andersson, *l. c.* 264. — Brandis, *l. c.* 470. — Boissier, *l. c.* 1191.

Salix longifolia, Lamarck, *Fl. Franç.* ii. 232 (1778).

Salix Gmelini, Pallas, *Fl. Ross.* i. pt. ii. 77 (1788).

Salix virescens, Villars, *l. c.* 785 (1789).

Salix serotina, Pallas, *Reise*, iii. 759 (1776).

Salix viminalis, a shrub or small tree, is widely scattered over northern, central, and southeastern Europe, western Asia, northeastern India, Siberia, and Manchuria. Its long tough branches are used in basket-weaving, and in Europe it is considered the most valuable of the Osier Willows.

[4] Linnæus, *l. c* 1017 (1753). — Host, *l. c.* 12, t. 40, 41. — Forbes, *l. c.* i. t. — Ledebour, *Fl. Ross.* iii. 602. — Reichenbach, *l. c.* 22, t. 582, 583, 584. — Hartig, *l. c.* 413, t. 53. — Willkomm & Lange, *l. c.* 227. — Wimmer, *l. c.* 29. — Parlatore, *l. c.* 229. — Andersson, *l. c.* 306. — Boissier, *l. c.* 1186. — Bebb, *Watson & Coulter Gray's Man.* ed. 6, 484.

Salix Helix, Linnæus, *l. c.* (1753). — Desfontaines, *Fl. Atlant.* ii. 362. — Forbes, *l. c.* 3, t.

Salix rubra, Hudson, *Fl. Angl.* 364 (1762). — Smith & Sowerby, *l. c.* xvi. t. 1145. — Reichenbach, *l. c.* t. 586. — Andersson, *l. c.* 307.

Salix pratensis, Scopoli, *Fl. Carn.* ed. 2, ii. 252 (1772).

Salix monandra, G. F. Hoffmann, *l. c.* 18, t. 1, f. 1, 2 ; t. 5, f. 1 (1787). — Seringe, *l. c.* 5. — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 297. — Forbes, *l. c.* 7.

Salix fissa, G. F. Hoffmann, *l. c.* 61, t. 13, f. 14, f. 1–4 (1787).

Salix membranacea, Thuillier, *Flore Par.* ed. 2, ii. 515 (1790).

Salix olivacea, Thuillier, *l. c.* (1790).

Salix Forbyana, Smith, *l. c.* 1041 (1804). — Smith & Sowerby, *l. c.* xix. t. 1344. — Forbes, *l. c.* 9, t. 5.

Salix Lambertiana, Smith, *l. c.* (1804). — Willdenow, *l. c.* 673. — Smith & Sowerby, *l. c.* t. 1359. — Forbes, *l. c.* 5.

Salix mollissima, Wahlenberg, *Fl. Carp.* 317 (not Ehrhart) (1814).

cultivated for this purpose.[1] Salix is also cultivated to furnish hoop-poles, to protect the banks of streams by preventing the soil from washing away from steep slopes, and to supply fodder for domestic animals. The bark of Salix is rich in tannic acid, and is employed in tanning leather;[2] and salicine, a bitter principle, makes it valuable as a tonic and antiperiodic, and in the treatment of rheumatism.[3]

In North America Salix is attacked by numerous insects,[4] which, with few exceptions, affect only

Salix Pontederana, Schleicher, *Cat. Pl. Helv.* ed. 3, 25 (not Willdenow) (1815).

Salix rosea, J. E. Gray, *Nat. Arr. Brit. Pl.* ii. 231 (1821).

Salix bifurcata, Chevallier, *Flore Envir. Paris*, ii. 357 (1827).

Salix oppositifolia, Host, *Salix*, 11, t. 38, 39 (1828).

Salix Carniolica, Host, *l. c.* 13, t. 44, 45 (1828); *Fl. Austr.* ii. 641.

Salix mirabilis, Host, *l. c.* 13, t. 46 (1828).

Salix discolor, Host, *l. c.* 18, t. 60, 61 (not Muehlenberg) (1828).

Salix Austriaca, Host, *l. c.* 19, t. 64 (1828).

Salix pendulina, Wenderoth, *Schrift. Nat. Gesell. Marb.* ii. 235 (1831).

Salix Woolgariana, Borrer, *Smith & Sowerby English Bot.* Suppl. i. t. 2651 (1831).

Salix concolor, Host, *Fl. Austr.* ii. 639 (1831).

Salix pallida, Ledebour, *Fl. Alt.* iv. 261 (1833).

Salix tenuijulis, Ledebour, *l. c.* 262 (1833); *Icon.* v. t. 453.

Salix Ledebouriana, Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 631 (1837).

Salix amplexicaulis, Bory et Chaubard, *Flore Pélop.* 64, t. 36 (1838).

Salix Elbrusensis, Boissier, *Diag. Pl. Or. Nov.* sér. 1, fasc. xii. 117 (1846).

Salix purpurea, η *Lambertiana*, Reichenbach, *Icon. Fl. German.* xi. 22, t. 585 (1849).

Salix hippophaëfolia (?), Ledebour, *Fl. Ross.* iii. 601 (not Thuillier) (1849).

Salix Kochiana, Hartig, *Forst. Culturpfl. Deutschl.* 569 (1851).

Salix Wimmeriana, Grenier & Godron, *Fl. Franç.* iii. 130 (1855).

Salix Baumgarteniana, Schur, *Enum. Pl. Transs.* 618 (1866).

Salix monadelpha, Schur, *l. c.* (1866).

Salix purpurea, which is a tall shrub and one of the most variable of the Old World Willows, is distributed through Europe from central Scandinavia southward, and through northern Africa and western Asia. It is often cultivated as an osier plant, and in the United States it has been more frequently planted in osier beds than any other species, although in the dry hot climate of the central states it appears to produce less valuable material than in Europe. The bitterness of the twigs and leaves protects it from browsing animals and increases its value as a hedge plant (Scaling, *The Cultivation of the Willow or Osier*, 25).

[1] The cultivation of Willows to produce vigorous shoots for basket-making has been practiced for centuries in Holland, Belgium, Germany, and France, and became an important industry in Great Britain during the first years of the present century, many thousand acres of ground being devoted in Europe to it. Several species are used in different countries, and nearly all Willows when properly cultivated yield shoots suitable for the purpose. Strong low but well drained soil, heavily manured and kept free from weeds, produces the most valuable shoots. Plantations are made by inserting cuttings in straight lines, the distance between the plants varying according to the species used and the practice of different cultivators. Osier holts, as these plantations are usually called in England, continue productive for many years, and annually furnish five or six tons of shoots to the acre. (See Wade, *Salices*, 407. — Loudon, *Arb. Brit.* iii. 1458. — Motrier, *Traité Pratique de la Culture de l'Osier*. — Scaling, *The Cultivation of the Willow or Osier*.)

The cultivation of Willows for basket-making has become established in the United States, especially in the neighborhood of Syracuse in the state of New York, where several thousand persons are engaged during the winter months in the manufacture of coarse baskets, and in New Jersey and Maryland, and in the neighborhood of Cincinnati and St. Louis. Osier holts in the United States are rarely more than a few acres in extent, and are usually composed of *Salix purpurea*, only coarse baskets being made from American grown material, a large part of the Willow shoots used in the United States in the manufacture of baskets being still imported from Europe. (See Porcher, *Resources of Southern Fields and Forests*, 335. — *Rep. Dep. Agric. U. S.* 1872, 452; 1873, 254; 1886, 223; 1888, 285.)

In Japan Osiers of different species are plaited into coarse hats, baskets, and other articles of wicker-work. (See Rein, *Industries of Japan*, 173.)

The tough bast-like inner bark peeled from Osier shoots is used in Europe in dyeing, and is manufactured into paper. (See Spons, *Encyclopædia of the Arts, Industries, and Raw Commercial Products*, i. 995.)

[2] Bartholdi, *Allgemeiner Journal der Chemie*, viii. 294 (*Chemische Untersuchung der Rinde der gemeinen weissen Weide*). — Johanson, *Beiträge zur Chemie der Eichen, Weiden und Ulmenrinde*. — Eitner, *Neue Bezugsquelle für Weidenrinde, Der Gerber*, iii. 109. — Höhnel, *Die Gerberinden*, 87.

[3] Porcher, *l. c.* 334. — Aubert, *Étude sur les Saules et la Salicine*, 49. — Guibourt, *Hist. Drog.* ed. 7, ii. 312. — Johnson, *Man. Med. Pl. N. Am.* 253. — *U. S. Dispens.* ed. 16, 1315.

[4] With the exception of the genus Quercus, Salix affords food to a larger number of insect species than any other genus of North American trees. Kaltenbach gives a list of three hundred and ninety-six species found upon Willows in Europe, and Packard enumerates two hundred and twenty-three which occur upon Salix in North America, although not all of them have been identified. Little is known of the borers which infest the wood of the living trunks and branches; but among the Lepidoptera one or more species of Cossidæ have been observed, and among beetles several species of Bupestris and Saperda. One of the most destructive pests to the plants of this genus is *Cryptorhynchus Lapathi*, Linnæus, a beetle of probably recent introduction from Europe, whose larvæ have become exceedingly destructive to the stems of many species of native Willows in different parts of the Atlantic states.

Leaf-eating Lepidoptera are abundant on Salix in North America, being represented by many genera, and in some genera, like Catocala, Apatela, and Cerura, by numerous species. The gregarious and bristly black larvæ of *Vanessa Antiopa*, Linnæus, are sometimes so abundant as to strip limbs or whole trees of their foliage, and species of Limenitis and other butterflies are often common

the leaves and young growing shoots; and the genus is subject to serious fungal diseases, although these are not so numerous as those found in some other large genera.[1]

The species of Salix can be readily raised from seeds and from cuttings of large or small branches inserted in the open ground in the spring. The hardiness of most of the Willows, the ease with which they can be cultivated, and the beauty of their flowers and foliage, make many of the species desirable ornamental plants. Several of the arborescent forms grow rapidly into shapely trees, although they are often disfigured by the breaking of the branches, which are easily separated at the joints by high winds.

Salix, the classical name of the Willow, was adopted by Tournefort[2] and other pre-Linnæan botanists as the name of the genus.

on Willows, although rarely troublesome. A few species of Sphingidæ live upon the Willows. Bombycidæ are much more abundant, and larvæ of most of the large American silk-worms will feed upon the leaves, while Tussock Moths and Fall Web-worms frequently do them much damage. *Deilinia variolaria*, Guenée, and other span-worms occur upon Willows in varying numbers in different localities and seasons.

Species of Lithocolletis, Gelechia, Nepticula, Aspidisca, and other Tineids mine the leaves, their larvæ living within tortuous or blotch mines between the epidermal layers. Larvæ of *Crepidodera Helxines*, Linnæus, *Lina scripta*, Fabricius, *Lina Lapponica*, Linnæus, *Galeruca decora*, Say, and other Chrysomelidæ are sometimes very abundant and are frequently the most destructive of the foliage-eating beetles.

Saw-fly larvæ of numerous species prey upon American Willows. The large *Cimbex Americana*, Leach, has been found to damage seriously the young shoots by gnawing and girdling them, while the larvæ feed upon the foliage. Larvæ of *Nematus ventralis*, Say, are sometimes quite troublesome, several broods being produced during the season; and the larvæ of other species of Nematus, of Selandria, Dolerus, and other Tenthredinidæ, are frequently destructive to the foliage. *Phyllœcus integer*, Norton, has been found to girdle and destroy the tips and young shoots, in which the larvæ live as borers.

The leaves and twigs of the various species are subject to distortions and gall growths caused by many species of hymenopterous and dipterous insects. Among the former, various species of Euura and Nematus produce diversely shaped and often thick-walled galls which are borne on the leaves or twigs. But the most generally conspicuous and peculiar galls on Salix in North America are formed by the action of various species of Gall-gnats or Cecidomyidæ belonging to the order of Diptera. These galls are usually borne on young twigs and sometimes on the leaves, and are of a woody or a leafy character according to the species. *Cecidomyia Salicis-siliqua*, Walsh, produces a smooth oblong woody gall which occurs near the tips of the twigs of several species of Willow. Other galls of similar character but of various forms peculiar to certain Willows are recorded as distinct species. *Cecidomyia Salicis-triticoides*, Walsh, arrests the growth of the branchlets of *Salix cordata* and other species, causing the leaves to become more or less crowded, the affected part of the twig appearing after the leaves fall as a long swelling roughened by the prominent leaf-scars.

The most interesting and curious galls affecting the Willows are those which assume a cone-like shape at the tips of the branches of *Salix discolor*, *Salix humilis*, *Salix cordata*, and other species. *Cecidomyia Salicis-strobiliscus*, Walsh, may be taken as an example; it is an ovate cone-like gall usually about an inch and a half long and three fourths of an inch or more in diameter in its widest part. It is formed of many overlapping scales which are suppressed, modified, and crowded leaves, and the solitary larva lives and pupates in its centre. Minute galls of curious forms are also produced upon the leaves by species of Phytoptus or mites.

Willows are often infested by several species of aphids of such genera as Lachnus, Chaitophorus, and Rhopalosiphon; and scale insects, chiefly of the genera Chionaspis and Aspidiotus, sometimes injure them.

[1] The leaves of most species of Salix are infested by a common mildew, *Uncinula Salicis*, Winter, which covers them late in the season with a thick white web, and are also liable to be attacked by fungi of the genus Melampsora. Several species of this genus have been noticed in North America, but their distinctive characters are not well understood, and, as is the case with the Melampsoræ which attack the species of Populus, writers do not agree in regard to the plants on which the æcidial conditions exist. *Rhytisma salicinum*, Fries, a common and conspicuous fungus which forms slightly raised black patches often of considerable size on the leaves of Salix, is found on many of the American species. This fungus is abundant in all parts of the country from the sea-coast to alpine regions. In spring and early summer the small branches of *Salix discolor* are so densely covered with small powdery black spots that the hands of a person breaking off a branch are often blackened. This fungus, which belongs to the group of Fungi Imperfecti, has received several names in America, the latest being *Trimmatostroma Americanum*, Thümen, although it is probably not different from *Trimmatostroma Salicis*, Corda, of Europe. Of the larger fungi belonging to the Polyporei, or Punk-fungi, *Trametes suaveolens*, Fries, recognized by its color, which is at first white and later yellow, and by its anise-like odor, and *Polyporus salicinus*, Fries, are found on Willows in the United States. Among the other hymenomycetous fungi that attack Salix in North America are *Agaricus salignus*, Schrader, the characteristic *Corticium Oakesii*, Berkeley & Curtis, and the pretty blood-colored *Corticium cruentum*, Schrader, found on fallen branches in moist places.

[2] *Inst.* 590, t. 364.

CONSPECTUS OF THE NORTH AMERICAN ARBORESCENT SPECIES.

PLEIANDRÆ.

Aments terminal on leafy branches; stamens 3 or more, their filaments free and hairy at the base; scales deciduous from the pistillate ament before the ripening of the fruit. Bark dark and deeply furrowed, or in No. 8 nearly smooth.

- Leaves narrowly lanceolate, long-pointed, often falcate, green on both surfaces, glabrous at maturity . . . . . 1. S. NIGRA.
- Leaves lanceolate or ovate-lanceolate, silvery white on the lower surface . . . 2. S. WARDI.
- Leaves lanceolate, acuminate, pale, often silvery white, and glabrous or puberulous on the lower surface . . . . . 3. S. OCCIDENTALIS.
- Leaves lanceolate or ovate-lanceolate, acuminate, pale and glaucous on the lower surface . . . . . 4. S. AMYGDALOIDES.
- Leaves lanceolate or oblong-lanceolate, acute or acuminate, blue-green on the upper surface, pale or glaucous on the lower . . . . . 5. S. LÆVIGATA.
- Leaves lanceolate, taper-pointed, often pale or glaucous on the lower surface, their petioles glandular . . . . . 6. S. LASIANDRA.
- Leaves linear-lanceolate or oblong-lanceolate, often falcate, silvery white on the lower surface, persistent during the winter . . . . . 7. S. BONPLANDIANA.
- Leaves lanceolate, long-pointed, coriaceous, dark green and lustrous, their petioles glandular . . . . . 8. S. LUCIDA.

DIANDRÆ.

Stamens 2, their filaments glabrous or slightly hairy at the base, free or more or less united in Nos. 16, 18, and 19. Bark usually smooth, or deeply fissured in No. 11.

Aments terminal and axillary on leafy branches.

- Leaves linear-lanceolate, usually green on both surfaces . . . . . 9. S. FLUVIATILIS.
- Leaves lanceolate or linear-lanceolate, villous on the lower surface with lustrous pale hairs . . . . . 10. S. SESSILIFOLIA.
- Leaves linear-lanceolate, pale gray-green, and puberulous . . . . . 11. S. TAXIFOLIA.

Aments terminal on abbreviated branches, their leaves often reduced to deciduous bracts; scales colored at the apex, persistent under the fruit.

- Leaves oblong-obovate or oblong-elliptical, conspicuously reticulate-venulose, dull green on the upper surface, glaucous or silvery white and pubescent on the lower . . . . . 12. S. BEBBIANA.
- Leaves oblong, oblong-obovate, or lanceolate, glaucous or silvery white on the lower surface . . . . . 13. S. DISCOLOR.
- Leaves lanceolate or oblanceolate, acuminate, dark green on the upper surface, pale on the lower . . . . . 14. S. CORDATA, var. MACKENZIEANA.
- Leaves lanceolate or oblanceolate, long-pointed, pale and often silvery white on the lower surface . . . . . 15. S. MISSOURIENSIS.
- Leaves oblanceolate or lanceolate-oblong, dark green on the upper surface, pale or glaucous and pubescent or puberulous on the lower . . . . . 16. S. LASIOLEPIS.
- Leaves oblong-obovate, acute or acuminate or rounded at the apex, yellow-green on the upper surface . . . . . 17. S. NUTTALLII.
- Leaves elliptical-oblong, obovate, or oblanceolate, dark green on the upper surface, and glaucous on the lower . . . . . 18. S. PIPERI.
- Leaves oblong or oblong-obovate, yellow-green and glabrous or tomentose on the upper surface, pale or glaucous and tomentose on the lower . . . . . 19. S. HOOKERIANA.
- Leaves oblong-obovate to oblanceolate, usually acute or acuminate, coated below with lustrous white tomentum . . . . . 20. S. SITCHENSIS.

SALIX NIGRA.

Black Willow.

LEAVES narrowly lanceolate, long-pointed, often falcate, green on both surfaces, glabrous at maturity.

Salix nigra, Marshall, *Arbust. Am.* 139 (1785). — Muehlenberg, *Neue Schrift. Gesell. Nat. Fr. Berlin*, iv. 237, t. 6, f. 5; *Konig & Sims Ann. Bot.* ii. 65, t. 5, f. 5. — Willdenow, *Spec.* iv. pt. ii. 657; *Enum.* 1003; *Berl. Baumz.* ed. 2, 426. — Persoon, *Syn.* ii. 599. — Wade, *Salices*, 33. — Stokes, *Bot. Mat. Med.* iv. 501. — Michaux f. *Hist. Arb. Am.* iii. 324, t. 5, f. 1. — Pursh, *Fl. Am. Sept.* ii. 614. — Poiret, *Lam. Dict.* Suppl. v. 61. — Nuttall, *Gen.* ii. 231; *Sylva*, i. 79. — Hayne, *Dendr. Fl.* 180. — Elliott, *Sk.* ii. 670. — Sprengel, *Syst.* i. 100. — Forbes, *Salict. Woburn.* 280. — Koch, *Sal. Europ. Comm.* 17. — Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 614. — Loudon, *Arb. Brit.* iii. 1529, 1630, f. 152. — Hooker, *Fl. Bor.-Am.* ii. 148. — Barratt, *Sal. Amer.* No. 19. — Torrey, *Fl. N. Y.* ii. 209. — Emerson, *Trees Mass.* 271; ed. 2, i. 307, t. — Dietrich, *Syn.* v. 419. — Seringe, *Fl. Jard.* ii. 35. — Darlington, *Fl. Cestr.* ed. 3, 279. — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 114 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 53; *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 19 (*Monographia Salicum*) (excl. subvars. *amygdaloides, longipes*, and *Wrightii*); *De Candolle Prodr.* xvi. pt. ii. 200 (excl. vars. β *amygdaloides*, γ *longipes*, and δ *Wrightii*). — Walpers, *Ann.* v. 744. — Chapman, *Fl.* 430. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 75. — K. Koch, *Dendr.* ii. pt. i. 513. — Bebb, *Brewer & Watson Bot. Cal.* ii. 83; *Bot. Gazette*, xvi. 102; *Watson & Coulter Gray's Man.* ed. 6, 480. — Ridgway, *Proc. U. S. Nat. Mus.* v. 86. — Hemsley, *Bot. Biol. Am. Cent.* iii. 180. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 165. — Dippel, *Handb. Laubholzk.* ii. 225, f. 111. — Koehne, *Deutsche Dendr.* 90. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 419 (*Man. Pl. W. Texas*). — Greene, *Man. Bot. Bay Region*, 299.

Salix pentandra?, Walter, *Fl. Car.* 243 (not Linnæus) (1788).

Salix Caroliniana, Michaux, *Fl. Bor.-Am.* ii. 226 (1803). — Poiret, *Lam. Dict.* vi. 662.

Salix ligustrina, Michaux f. *Hist. Arb. Am.* iii. 326, t. 5, f. 2 (1813). — Poiret, *Lam. Dict.* Suppl. v. 61.

Salix Houstoniana, Pursh, *Fl. Am. Sept.* ii. 614 (1814). — Poiret, *Lam. Dict.* Suppl. v. 68. — Sprengel, *Syst.* i. 107. — Elliott, *Sk.* ii. 670. — Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 615. — Forbes, *Salict. Woburn.* 21, t.

? Salix ambigua, Pursh, *Fl. Am. Sept.* ii. 617 (1814). — Forbes, *Salict. Woburn.* 282.

Salix flavo-virens, Hornemann, *Cat. Hort. Hafn.* Suppl. ii. 11 (1819).

? Salix virgata, Forbes, *Salict. Woburn.* 23, t. (1829).

? Salix longipes pubescens, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 114 (*Bidr. Nordam. Pilarter*) (1858); *Proc. Am. Acad.* iv. 53.

Salix nigra, a **angustifolia**, β **longifolia**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 20 (*Monographia Salicum*) (1867).

Salix nigra, b **latifolia**, α **brevijulis**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 21 (*Monographia Salicum*) (1867).

Salix nigra, b **latifolia**, β **longijulis**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 21 (*Monographia Salicum*) (1867).

Salix nigra, b latifolia, γ **brevifolia**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 21 (*Monographia Salicum*) (1867).

Salix nigra, b **latifolia**, γ **brevifolia testacea**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 21 (*Monographia Salicum*) (1867).

Salix nigra, subspec. **marginata**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 21 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 201.

? Salix nigra, subspec. **longipes gongylocarpa**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 22 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 201.

Salix nigra, β **latifolia**, Dippel, *Handb. Laubholzk.* ii. 226 (1892).

A tree, occasionally one hundred and twenty feet in height, with a trunk three feet in diameter, and stout spreading rather upright branches which form a broad and somewhat irregular but handsome open head; or usually thirty or forty feet high, with trunks which are often clustered. The bark of the trunk varies from an inch to an inch and a quarter in thickness and is dark brown or nearly black, or

sometimes lighter brown and slightly tinged with orange-color, and is deeply divided into broad flat connected ridges, their surface separating into thick plate-like scales. The branchlets are slender, very brittle at the base, rather bright reddish brown or in the desert region of New Mexico and Arizona pale orange-color, and glabrous or often coated at first with pale pubescence or snowy tomentum which soon disappears. The winter-buds are acute and about a sixteenth of an inch long, and in color resemble the branches. The leaves are involute in the bud, lanceolate, gradually narrowed above the middle into long tapering and usually curved tips, and below into a wedge-shaped or somewhat rounded base, and serrate with minute reflexed remote teeth; when they unfold they are coated, especially on the lower surface, with pale pubescence, and at maturity are thin, bright light green, rather lustrous, obscurely reticulate-venulose, and glabrous, or often pubescent on the under side of the midribs and arcuate veins and on the short slender petioles; they are from three to six inches long and from one eighth to three quarters of an inch wide, varying greatly in size and outline on different individuals, and are frequently conspicuously scythe-shaped,[1] especially on trees growing in the northeastern states; the first pair are ovate, acute, coated with pale silky hairs, and disappear when less than an inch in length. The stipules are semicordate, acuminate, foliaceous, and persistent, or ovoid, minute, and deciduous. Late in the autumn the leaves turn light yellow before falling, but often, especially in the south, fall without change of color. The aments, which appear from the first of February in southern Arizona to the middle of June in northern New England, are borne on short leafy branches often prolonged by one of the upper axillary buds, and are narrowly cylindrical and from one to three inches in length; their scales are remotely subverticillate, short, rounded at the apex, yellow, and coated on the inner surface with pale hairs. The stamens vary from three to five in number, with free filaments hairy toward the base. The ovary is ovate, glabrous, and gradually narrowed above the middle to the apex, which is crowned with nearly sessile thick slightly emarginate stigmatic lobes. Before the fruit ripens the scales fall from the pistillate aments, which, when fully grown, vary from an inch and a half to three inches in length. The capsule is ovate, conical, short-stalked, glabrous, about an eighth of an inch long, and light reddish brown.

Salix nigra inhabits the banks of streams and lakes, over which it often extends its trunks and branches, and is distributed from southern New Brunswick and the northern shores of Lakes Huron and Superior[2] southward to southern Florida, westward to eastern Dakota,[3] Nebraska,[4] Kansas,[5] and the Indian Territory, and through western Texas,[6] southern New Mexico and Arizona, and southward into Mexico, and along the western foothills of the Sierra Nevada northward to the valley of the Sacramento River and to the shores of Clear Lake at the eastern base of the Coast Range in Colusa County, California. It is the largest and most conspicuous native Willow of eastern North America, and is most abundant in the basin of the Mississippi River, growing probably to its greatest size in southern Indiana and Illinois and in the valley of the lower Colorado River in Texas. It is the common arborescent Willow on the banks of streams in western Texas,[7] and southern New Mexico and Arizona, where it frequently attains a height of forty feet and forms a trunk four feet in diameter, and a broad round-topped symmetrical head. The Black Willow apparently does not grow in any part of the northern interior region of the continent, and is comparatively rare in California.

The wood of *Salix nigra* is light, soft, weak, and close-grained, checking badly in drying; it

[1] *Salix nigra*, var. *falcata*, Torrey, *Fl. N. Y.* ii. 209 (1843). — Carey, *Gray's Man.* 429. — Darlington, *Fl. Cestr.* ed. 3, 280. — Bebb, *Gray's Man.* ed. 6, 481. — Dippel, *Handb. Laubholzk.* ii. 226, f. 112.

Salix falcata, Pursh, *Fl. Am. Sept.* ii. 614 (1814). — Poiret, *Lamarck Dict.* Suppl. v. 70. — Sprengel, *Syst.* i. 107. — Forbes, *Salict. Woburn.* 279. — Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 613. — Hooker, *Fl. Bor.-Am.* ii. 149. — Dietrich, *Syn.* v. 420.

Salix Purshiana, A. F. Sprengel, *Syst.* v. 608 (1828). — Trautvetter, *l. c.* 626. — Darlington, *Fl. Cestr.* ed. 2, 560. — Barratt, *Sal. Amer.* No. 21.

[2] Provancher, *Flore Canadienne*, ii. 529. — Macoun, *Cat. Can. Pl.* 451.

[3] Williams, *Bull.* No. 43, *South Dakota Agric. Coll.* 107.

[4] Bessey, *Rep. Nebraska State Board Agric.* 1894, 103.

[5] Mason, *Eighth Bienn. Rep. State Board Agric. Kansas*, 272.

[6] Bebb, *Garden and Forest*, viii. 363.

[7] Havard, *Proc. U. S. Nat. Mus.* viii. 502.

contains obscure medullary rays, and is light reddish brown, with thin nearly white sapwood. The specific gravity of the absolutely dry wood is 0.4456, a cubic foot weighing 27.77 pounds.

The bark is frequently used domestically as a tonic in the treatment of fevers.

First described by Humphry Marshall[1] in the *Arbustum Americanum* published in 1785, *Salix nigra* was introduced into the Botanic Garden of Berlin before 1805.[2]

[1] See viii. 39.

[2] Willdenow, *Spec.* iv. pt. ii. 657.

EXPLANATION OF THE PLATES.

Plate CCCCLXII. Salix nigra.

1. A flowering branch of the staminate tree, natural size.
2. Diagram of a staminate flower.
3. A staminate flower with its scale, front view, enlarged.
4. A stamen, enlarged.
5. A flowering branch of the pistillate tree, natural size.
6. Diagram of a pistillate flower.
7. A pistillate flower with its scale, front view, enlarged.
8. Vertical section of a pistil, enlarged.
9. An ovule, much magnified.
10. A fruiting branch, natural size.
11. A capsule, enlarged.
12. A seed, enlarged.
13. Vertical section of a seed, enlarged.
14. A summer branch, natural size.
15. A winter branch, natural size.

Plate CCCCLXIII. Salix nigra, var. falcata.

1. A flowering branch of the staminate tree, natural size.
2. A flowering branch of the pistillate tree, natural size.
3. A staminate flower with its scale, front view, enlarged.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A sterile branch, natural size.

C.E. Faxon del. *Lövendal sc.*

SALIX NIGRA, Marsh.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

C.E. Faxon del.

Lövendal sc.

SALIX NIGRA, var. FALCATA, Torr.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

SALIX WARDI.

Black Willow.

LEAVES lanceolate or ovate-lanceolate, silvery white on the lower surface.

Salix Wardi, Bebb, *Garden and Forest*, viii. 363 (1895). — Glatfelter, *Science*, n. ser. ii. 582.

Salix cordata, β angustata, 1° discolor, Andersson, *De Candolle Prodr.* xvi. pt. ii. 252 (1868).

Salix nigra, var. **Wardi**, Bebb, *Ward Bull. U. S. Nat. Mus.* No. 22, 114 (*Fl. Washington*) (1881); *Watson & Coulter Gray's Man.* ed. 6, 481. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 166.

A tree, occasionally thirty feet in height, with a single trunk six or eight inches in diameter, and slender spreading slightly drooping branches; usually smaller and frequently shrubby in habit. The bark of the trunk and principal branches is from one quarter to one half of an inch in thickness, dark reddish brown or nearly black, and deeply divided into broad connected ridges covered by small closely appressed plate-like scales. The branchlets are slender, and when they first appear are coated with hoary pubescence which often persists on vigorous shoots during the summer; and in their first winter they are chestnut-brown and rather lustrous. The winter-buds are bright chestnut-brown, lustrous, and about a sixteenth of an inch long. The leaves are involute in the bud, closely and often unequally serrate with minute incurved teeth, lanceolate or ovate-lanceolate, sometimes slightly falcate, rounded or cordate at the base, obliquely long-pointed, from four to seven inches in length and from an inch to an inch and a half in width; or they are linear-lanceolate, gradually rounded at the base, and often less than half an inch wide; when they unfold they are coated with pale pubescence thicker on the lower than on the upper surface, and at maturity they are bright light green above and silvery white below, with slender yellow midribs raised and rounded on the upper side and puberulous or pubescent on the lower, slender arcuate veins connected by obscure reticulate veinlets, and broad flat petioles which on the large leaves are sometimes three quarters of an inch long. The stipules are foliaceous, reniform, rhomboidal or oblong, obtuse, serrate above the middle, frequently half an inch broad, and sometimes persistent. The aments appear in May and June, or two or three weeks later than those of *Salix nigra*, and are terminal on leafy branches, which, before the ripening of the fruit, sometimes grow to a length of twelve or eighteen inches from one of the upper axillary buds; they are narrowly cylindrical, the staminate three or four inches long, subflexuose, and rather longer than the pistillate; their scales are subverticillately arranged on the slender villous rachis, and are ovate, obtuse, glabrous on the outer and villous on the inner surface, and orange-yellow. The stamens vary from three to six in number, with free filaments coated at the base with numerous long slender hairs. The ovary is globose, ovate or ovate-conical, short-stalked, and surmounted by the nearly sessile minute two-branched stigma. The fruiting aments, from which the scales fall before the capsules mature, are lax, spreading, and from three to four inches in length when fully grown. The capsule is globose-conical, about a quarter of an inch long, light reddish brown, minutely glandular, and long-stalked.

The range of *Salix Wardi* has not yet been well determined, but it is known to inhabit the banks of the Potomac River near the city of Washington, those of the Ohio in Kentucky,[1] central

[1] *Salix Wardi* was collected by Dr. Charles W. Short near the Falls of the Ohio River (now Lexington) in Kentucky, in 1840, and upon his specimen preserved in the Gray Herbarium Andersson founded the subvariety *discolor* of his *Salix cordata, β angustata* (*teste* Bebb, *Garden and Forest*, viii. 363).

Tennessee, Horse-shoe Lake near Venice, Illinois,[1] southern Missouri,[2] and in a few localities in the Indian Territory.

The wood of *Salix Wardi* is dark red-brown, with thin nearly white sapwood. It has not been examined scientifically.

Salix Wardi was first made known by Mr. Lester F. Ward,[3] who found it in 1876 in the neighborhood of the city of Washington.

[1] *Salix Wardi* has been found in 1895 by Dr. N. M. Glatfelter of St. Louis on the banks of Horse-shoe Lake, five miles west of Venice, Illinois, and eight miles northeast of St. Louis. It has also been observed by him at Bonterre, Pilot Knob, and Irondale, Missouri; and in 1894 it was collected in the vicinity of Sapulpa and of Verdigris in the Indian Territory, by Mr. B. F. Bush.

[2] In southwestern Missouri, where it is the only representative of the Black Willows, and is very abundant, *Salix Wardi* is usually a bush less than fifteen feet in height, and is confined to the rocky banks of streams and the beds of stony brooks that are usually dry during a large part of the year.

[3] Lester Frank Ward, the youngest of ten children, was born in Joliet, Illinois, on June 18, 1841, his father being a native of New Hampshire, and his mother, whose maiden name was Rolph, a member of the Loomis family of western New York. His boyhood was spent on his father's farm and in his wheelwright shop; but in 1859 he went to Pennsylvania to obtain an education. In 1862 he enlisted as a private in the 141st Regiment of Pennsylvania Volunteers, and served in the field until the battle of Chancellorsville, in which he was severely wounded. At the close of the war Mr. Ward obtained a clerkship in one of the government offices at Washington, and later was made librarian of the United States Bureau of Statistics, but resigned this position in 1881 to become a member of the staff of the Geological Survey of the United States, with which he is still connected. In 1881 he published, in Bulletin No. 22 of the United States National Museum, a guide to the flora of Washington and its vicinity, but since his connection with the Survey has occupied himself with fossil botany, upon which he has published important memoirs in the 5th, 6th, 8th, 15th, and 16th Annual Reports, and in Bulletin No. 37, devoted to a description of the Types of the Laramie Flora. Mr. Ward prepared the botanical definitions for *The Century Dictionary*, beginning with the letter H, and has contributed largely to scientific and popular journals. He is the author of *Dynamic Sociology* and the *Psychic Factors of Civilization*.

EXPLANATION OF THE PLATE.

PLATE CCCCLXIV. SALIX WARDI.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flower-scale, back view, enlarged.
4. A flowering branch of the pistillate tree, natural size.
5. A pistillate flower with its scale, front view, enlarged.
6. A fruiting branch, natural size.
7. A capsule, enlarged.
8. A sterile branch, natural size.
9. A winter branchlet, natural size.
10. An axillary bud and leaf-scar, enlarged.

C.E. Faxon del. *Himely sc.*

SALIX WARDII, Bebb.

A. Riocreux direx. *Imp. J. Taneur, Paris.*

SALIX OCCIDENTALIS.

Willow.

LEAVES lanceolate, acuminate, pale, often silvery white, and glabrous or puberulous on the lower surface.

Salix occidentalis, Koch, *Sal. Europ. Comm.* 16 (1828). — Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 23, t. 2, f. 16 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 202.

A small tree, rarely exceeding in the United States a height of twenty or thirty feet, with a trunk sometimes a foot in diameter. The bark of the trunk is dark brown or nearly black and deeply furrowed, with connected ridges covered by small closely appressed plate-like scales. The branchlets are coated with hoary tomentum which sometimes does not disappear until their second year, when they are rather light orange-brown. The buds are acute, light chestnut-brown, and about an eighth of an inch long. The leaves are revolute in the bud, lanceolate, gradually narrowed and wedge-shaped or rounded at the base, which is often unequal, long-pointed, occasionally slightly falcate, and closely serrate with minute incurved teeth; when they unfold they are coated with hoary tomentum, denser on the lower than on the upper surface, and at maturity they are thin and firm in texture, bright green and lustrous above, and pale or sometimes silvery white and often puberulous below, from two to six inches long and from one quarter to one half of an inch broad, or, on vigorous young shoots, sometimes seven or eight inches long and nearly two inches broad; they have yellow midribs raised and rounded on the upper side, slender arcuate veins connected by fine reticulate veinlets, and flattened grooved puberulous petioles rarely more than a quarter of an inch in length. The stipules are minute, ovate and acute or almost triangular, coated with hoary tomentum, and caducous; or, on vigorous shoots, they are foliaceous, reniform, rounded or acute at the apex, and sometimes three quarters of an inch broad. The aments are borne on short leafy branches whose leaves are usually oblong or oval, rounded at both ends, and from one to two inches in length, and are narrowly cylindrical, rather lax, and from two to four inches long; the scales are yellow, oblong-obovate, gradually narrowed at the apex and villous on the back. The stamens are generally five or six in number, with free filaments hairy toward the base. The ovary is oblong-conical, glabrous, long-stalked, and surmounted by a minute stigma with spreading emarginate lobes. The capsule is oblong-cylindrical, long-stalked, and about a quarter of an inch in length.

Salix occidentalis, which inhabits Cuba and Trinidad, and is the tropical representative of *Salix nigra*, to which it is closely related, is still very imperfectly known. In the United States the species is represented by the variety *longipes*,[1] which is distributed from the neighborhood of Jacksonville, Florida,[2] westward through Texas to New Mexico, Arizona and northern Mexico, and the southern Sierra Nevada of California.

[1] *Salix occidentalis*, var. *longipes*, Bebb, *Garden and Forest*, viii. 363 (1895). (See Plates ccccIxv., ccccIxvi.)

Salix longipes, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 114 (*Bidr. Nordam. Pilarter*) (? excl. var. *pubescens*) (1858); *Proc. Am. Acad.* iv. 53 (? excl. var. *pubescens*).

Salix Wrightii, Andersson, *Öfvers Vetensk. Akad. Förhandl. l. c.* 115 (1858); *Proc. Am. Acad. l. c.* 55 (according to Bebb [*l. c.*], only a monstrous form with abbreviated aments caused by the contraction of the rachis).

Salix nigra, subspec. *longipes*, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 22 (*Monographia Salicum*) (? excl. var. *gongylocarpa* [1867]; *De Candolle Prodr.* xvi. pt. ii. 201 (? excl. *gongylocarpa*).

Salix nigra, subspec. *longipes venulosa*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* (1867); *De Candolle Prodr. l. c.*

Salix nigra, subspec. *Wrightii*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* (1867); *De Candolle Prodr. l. c.* — Bebb, *Bot. Gazette*, xvi. 103. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 419 (*Man. Pl. W. Texas*).

Salix nigra venulosa, Coville, *Contrib. U. S. Nat. Herb.* iv. 199 (*Bot. Death Valley Exped.*) (1893).

[2] *Salix occidentalis*, var. *longipes*, has been collected in the neigh-

In the United States *Salix occidentalis*, var. *longipes*, was first collected by Charles Wright[1] in New Mexico in 1851, and in Florida was discovered by the German collector Rugel.[2]

The wood of *Salix occidentalis* has not been examined.

borhood of Jacksonville, Florida, by Mr. A. H. Curtiss (*Second Distribution of Southern Plants*, Nos. 4523, 4524), by Rugel at Saint Mark's, by Faxon and Sargent, in 1886, on the banks of the Miami River, and by Chapman and Mohr near Appalachicola. In Texas it was collected in 1894 near Kerrville, Kerr County, by Mr. A. A. Heller (Nos. 1643 and 1902). It appears to be not uncommon in the desert region of southern Nevada, and on the Tulare Plains of California, where it grows in moist soil near springs and streams, and is planted as a shade-tree (Coville, *Contrib. U. S. Nat. Herb.* iv. 199 (*Bot. Death Valley Exped.*).

[1] See i. 94.

[2] Ferdinand Rugel (December 24, 1806–December 31, 1879), who was born and educated at Weingarten in Baden, came to the United States in 1840 and devoted several years to collecting plants in the southern states and in Cuba for the English botanist Robert James Shuttleworth, whose herbarium is preserved in the British Museum. Rugel afterwards established himself in Knoxville, Tennessee, as an apothecary and doctor, and for many years also carried on a farm in Jefferson County, Tennessee, on which he died. His services to American botany are commemorated in *Rugelia*, now reduced to Senecio, an herb discovered by him on the high summits of the Big Smoky Mountains of Tennessee and North Carolina.

EXPLANATION OF THE PLATES.

PLATE CCCCLXV. SALIX OCCIDENTALIS.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A pistillate flower with its scale, front view, enlarged.
4. A fruiting branch, natural size.
5. A capsule, enlarged.
6. A sterile branch, natural size.

PLATE CCCCLXVI. SALIX OCCIDENTALIS.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A fruiting branch, natural size.
4. A capsule, enlarged.
5. A capsule with open valves, enlarged.

C.E.Faxon del. *Himely. sc.*

SALIX OCCIDENTALIS, Koch.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

C.E.Faxon del. Rapine sc.

SALIX OCCIDENTALIS. Koch.

A.Riocreux direx.t Imp. J.Taneur, Paris.

SALIX AMYGDALOIDES.

Peach Willow. Almond Willow.

LEAVES lanceolate or ovate-lanceolate, acuminate, pale and glaucous on the lower surface, long-stalked.

Salix amygdaloides, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 114 (*Bidr. Nordam. Pilarter*) (1858); *Proc. Am. Acad.* iv. 53. — Walpers, *Ann.* v. 744. — Bebb, *Rothrock Wheeler's Rep.* vi. 240; *Coulter Man. Rocky Mt. Bot.* 334; *Watson & Coulter Gray's Man.* ed. 6, 481. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 166. — Glatfelter, *Rep. Missouri Bot. Gard.* v. 52, t. 1, f. 7; *Science*, n. ser. ii. 583.

Salix nigra amygdaloides, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 21 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 201. — Rothrock, *Pl. Wheeler*, 50. — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* No. 4, 128.

A tree, sometimes sixty or seventy feet in height, with a single straight or slightly inclining trunk rarely more than two feet in diameter, and straight ascending branches; or usually much smaller. The bark of the trunk is from one half to three quarters of an inch in thickness, brown somewhat tinged with red, and divided by irregular fissures into flat connected ridges separating on the surface into thick plate-like scales. The branchlets are slender, glabrous, marked with scattered pale lenticels and not easily separable at the joints; during their first season they are dark orange-color or red-brown and lustrous, becoming in the winter light orange-brown. The winter-buds are broadly ovate, gibbous, dark chestnut-brown and very lustrous above the middle, light orange-brown below, and one eighth of an inch long. The leaves are revolute in the bud, lanceolate or ovate-lanceolate, frequently falcate, wedge-shaped or gradually rounded and often unequal at the base, gradually or abruptly narrowed into long slender points at the apex, and finely serrate with minute obtuse gland-tipped teeth; when they unfold they are slightly puberulous, especially below, and at maturity are thin and firm in texture, light green and lustrous on the upper surface and pale and glaucous on the lower, with stout yellow or orange-colored midribs impressed or raised on the upper side, prominent veins arcuate and connected near the margins, and conspicuous reticulate veinlets; they are from two and a half to four inches long and from three quarters of an inch to an inch and a quarter wide, and are borne on elongated slender nearly terete petioles from one half to three quarters of an inch in length; or, on vigorous shoots, the leaves are often rounded or cordate at the base, eight or nine inches long and two inches wide; those at the base of the branchlet are scale-like, ovate, acute, coated with long silky pale hairs, and caducous. The stipules are reniform, serrate with remote glandular teeth, frequently half an inch broad on vigorous shoots, and usually caducous. The flowers are borne on leafy branches in elongated cylindrical slender erect pedunculate pubescent or tomentose aments from two to three inches in length, the pistillate often becoming lax at maturity by the lengthening of the slender stalks of the capsules; their scales are yellow, sparingly villous on the outer and densely villous on the inner face, broadly ovate and rounded at the apex on the staminate ament, and oblong-obovate, narrower, and caducous on the pistillate. The stamens are usually from five to nine in number, with free filaments slightly hairy at the base. The ovary is oblong-conical, glabrous, long-stalked, and crowned by a short style divided into two stigmatic emarginate lobes. The capsule is globose-conical, light reddish yellow, and about a quarter of an inch in length.

Salix amygdaloides inhabits the banks of streams and is distributed from the neighborhood of

Montreal, Canada,[1] and Cayuga County, New York,[2] to the valley of the upper Saskatchewan,[3] southward to Ohio and Missouri, and westward over the great plains and through the Rocky Mountains from southwestern Texas[4] to Oregon, Washington, and British Columbia; comparatively rare in the east, it becomes abundant in the region about the mouth of the Ohio River, where it grows with *Salix nigra;* farther west it replaces that tree and is the common arborescent Willow along the banks of the rivers which flow eastward from the Rocky Mountains, and in all the central mountain region of the continent. Still imperfectly known in the territory west of the Rocky Mountains, *Salix amygdaloides* is probably less common there than on streams flowing toward the Gulf of Mexico.

The wood of *Salix amygdaloides* is light, soft, not strong, and close-grained; it contains numerous thin medullary rays, and is light brown, with thick nearly white sapwood. The specific gravity of the absolutely dry wood is 0.4509, a cubic foot weighing 28.10 pounds.

[1] *Salix amygdaloides* was discovered at Chateaugay in the Province of Quebec by Mr. J. G. Jack, in August, 1894.

[2] Dudley, *Bull. Cornell University*, ii. 87 (*Cayuga Fl.*).

[3] Macoun, *Cat. Can. Pl.* 444.

[4] Coulter, *Contrib. U. S. Nat. Herb.* ii. 419 (*Man. Pl. W. Texas*).

EXPLANATION OF THE PLATE.

PLATE CCCCLXVII. SALIX AMYGDALOIDES.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A winter branch, natural size.
8. A bud and leaf-scar, enlarged.
9. A stipule of a vigorous shoot, natural size.

C.E.Faxon del. Lövendal sc.

SALIX AMYGDALOIDES, Anders.

A.Riocreux dirext. Imp. J.Taneur, Paris.

SALIX LÆVIGATA.

Black Willow.

LEAVES lanceolate or oblong-lanceolate, acute or acuminate, pale or glaucous on the lower surface.

Salix lævigata, Bebb, *Am. Nat.* viii. 202 (1874); *Brewer & Watson Bot. Cal.* ii. 83; *Bot. Gazette*, xvi. 103. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 167. — Mayr, *Wald. Nordam.* 287. — Coville, *Contrib. U. S. Nat. Herb.* iv. 198 (*Bot. Death Valley Exped.*). — Greene, *Man. Bot. Bay Region*, 299. — S. B. Parish, *Zoë*, iv. 347.

A tree, forty or fifty feet in height, with a straight trunk occasionally two feet in diameter, although usually not more than twelve or fifteen inches through, and slender spreading branches; or often much smaller, with an average height of twenty or thirty feet. The bark of the trunk is from three quarters of an inch to an inch in thickness, dark brown slightly tinged with red, and deeply divided into irregularly connected narrow flat ridges broken on the surface into thick closely appressed scales; that of young stems and of the branches is dark and broken by shallow fissures. The branchlets, which are slender, and coated when they first appear with hoary deciduous pubescence, are light or dark orange-color or rather bright red-brown. The winter-buds are ovate, somewhat obtuse, from an eighth to a quarter of an inch in length, pale chestnut-brown and lustrous above the middle, and pale below. The leaves[1] are involute in the bud, with slightly revolute obscurely serrate margins; they are obovate, gradually narrowed and wedge-shaped at the base, and narrowed and rounded or acute and mucronate at the apex; and on sterile branches they are lanceolate or oblong-lanceolate, and acute or acuminate; when they unfold they are light blue-green and coated on the lower surface with long pale or tawny deciduous hairs; and at maturity they are glabrous, dark blue-green and lustrous above and paler or glaucous below, from three to seven inches long and from three quarters of an inch to an inch and a half wide, with broad flat yellow midribs, slender arcuate primary veins prominent and conspicuous on the upper surface and obscure on the lower, and broad grooved puberulous petioles rarely half an inch in length; those at the base of the shoot are scale-like, coated on the lower surface with long pale or tawny hairs which also form at their apex a long conspicuous fringe which protrudes from the unfolding bud. The stipules are ovate, acute, finely serrate, usually small, and caducous. The flowers are borne on leafy branches in slender lax elongated cylindrical pedunculate aments which vary from two to four inches in length;[2] their scales are pallid, dentate at the apex, and covered with long pale hairs, those of the staminate ament being obovate, rounded and broader than those of the pistillate ament, which are more or less truncate. The stamens are usually five or six in number, with free filaments hairy at the base. The ovary is ovate, conical, rounded below, rather short-stalked, and glabrous; the style is short or wanting, and the broad spreading stigmatic lobes are notched at the apex. The capsule is elongated-conical, long-stalked, and nearly a quarter of an inch in length.

Salix lævigata inhabits the banks of streams and is distributed through western California from Siskiyou County, near the Oregon boundary, to the southern borders of the state, ascending on the western slopes of the Sierra Nevada to elevations of from two to three thousand feet.

[1] A form with narrow long-pointed falcate leaves three or four inches in length and three quarters of an inch wide near the rounded base, found by Mr. Edward L. Greene near Yreka, California, is described as var. *angustifolia* (Bebb, *Brewer & Watson Bot. Cal.* ii. 84 [1880]).

[2] A form with short densely flowered aments and globose conical short-stalked capsules is described as var. *congesta* (Bebb, *l. c.* [1880]).

The wood of *Salix lævigata* is light, soft, not strong, brittle, and close-grained. It is light brown tinged with red, with thick nearly white sapwood, and contains numerous thin medullary rays. The specific gravity of the absolutely dry wood is 0.4872, a cubic foot weighing 30.36 pounds.

EXPLANATION OF THE PLATE.

PLATE CCCCLXVIII. SALIX LÆVIGATA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A winter branch, natural size.
8. A bud, enlarged.

C.E. Faxon del. Rapine sc.

SALIX LAEVIGATA, Bebb.

A. Riocreux direx.t Imp. J. Taneur, Paris.

SALIX LASIANDRA.

Black Willow.

LEAVES lanceolate, taper-pointed, often pale or glaucous on the lower surface; petioles glandular.

Salix lasiandra, Bentham, *Pl. Hartweg.* 335 (1857). — Torrey, *Pacific R. R. Rep.* iv. pt. v. 138. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 89. — Bebb, *Brewer & Watson Bot. Cal.* ii. 84; *Bot. Gazette,* xvi. 103. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 167. — Mayr, *Wald. Nordam.* 288. — Greene, *Man. Bot. Bay Region,* 299.

Salix Hoffmanniana, Hooker & Arnott, *Bot. Voy. Beechey,* 159 (not Smith) (1833).

Salix arguta lasiandra, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 33 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 206.

Salix lasiandra, var. **typica,** Macoun, *Cat. Can. Pl.* 449 (1886).

A tree, often sixty feet in height, with a trunk from two to three feet in diameter, and straight ascending branches which form an open irregular head and usually bear the largest leaves at their extremities; or toward the southern limits of its range and in the interior of the continent much smaller and sometimes shrubby. The bark of the trunk is from one half to three quarters of an inch in thickness, dark brown slightly tinged with red, and divided by shallow fissures into broad flat scaly ridges broken by cross fissures into oblong plates. The branchlets are rather stout, and when they first appear are dark purple, reddish brown, or yellow, pilose with scattered hairs, or pubescent or tomentose, and often covered with a glaucous bloom, becoming before the end of the first season dark purple, bright reddish brown, or light orange-color. The buds are broadly ovate, acute, light chestnut-brown and lustrous above the middle, pale at the base, and nearly a quarter of an inch in length. The leaves are involute in the bud, linear-lanceolate, long-pointed, gradually rounded at the narrowed base, and finely serrate with minute glandular teeth; when they unfold they are pilose on the upper surface and pubescent or tomentose on the lower, and at maturity are dark green and lustrous above, pale or glaucous below, conspicuously venulose, four or five inches long and from half an inch to an inch wide, with broad orange-colored midribs, slender arcuate veins, and glabrous or pubescent petioles from one quarter to one half of an inch in length, and furnished at the apex with two or more large dark glands. The first leaves are obovate or coated with thick lustrous white or rufous tomentum and fall soon after their appearance when they are only about an inch in length; those immediately above them and those on the flowering branches are oblong-obovate, gradually narrowed at the base and sessile or short-stalked, while those above these gradually assume the lanceolate form of the later leaves. The stipules are semilunar, glandular-serrate, small and deciduous or, on vigorous young shoots, usually large and foliaceous. The aments are terminal and pedunculate on leafy branches, arcuate, cylindrical, and from an inch and a half to two inches long, the staminate being sometimes a third of an inch in diameter when the flowers are expanded and nearly twice as broad as the pistillate aments; the scales are obovate, yellow, more or less villous below the middle, and glandular-dentate, especially those of the staminate ament, those of the pistillate being narrower and sometimes nearly entire. The stamens vary from five to nine in number, with free filaments hairy at the base. The ovary is cylindrical, lanceolate, glabrous, short-stalked, and tipped with a short style and spreading slightly emarginate stigmatic lobes. The capsule is light reddish yellow and about a quarter of an inch in length. A form of this species, *Salix lasiandra,* var. *Lyallii,*[1] varies in its longer leaves, tapering from the rounded or subcordate base,

Sargent, *Garden and Forest,* viii. 463 (1895).

Salix speciosa, Nuttall, *Sylva,* i. 58, t. 17 (not Hooker & Arnott) (1842).

Salix lucida angustifolia lasiandra, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 115 (*Bidr. Nordam. Pilarter*) (not *Salix angustifolia,* Willdenow) (1858); *Proc. Am. Acad.* iv. 54.

usually white on the lower surface and often seven or eight inches in length, in its more glandular petioles and the rather narrower and less hairy scales of its pistillate aments. Another variety, *Salix lasiandra*, var. *caudata*,[1] is distinguished by its thicker and more coriaceous usually smaller and often more or less falcate leaves wedge-shaped at the base and green on both surfaces, by its much thicker and more densely flowered staminate aments, with scales generally dentate near the apex only, by its yellow branchlets, its larger buds often villous, especially below the middle, and its smaller size.

Salix lasiandra is a common inhabitant of river banks and the shores of lakes in California west of the Sierra Nevada. In western Oregon, Washington, and southern British Columbia, where it ranges as far north, at least, as the Selkirk Mountains,[2] it is often replaced by the variety *Lyallii*, which is one of the most beautiful of the American Willows, and in western Oregon and Washington one of the commonest trees on river banks and in other low and moist situations, its tall stems often growing in clusters; and in the interior of the continent by the variety *caudata*, which is distributed from the Sierras of northern California to northern Montana, Colorado, and northern New Mexico.[3]

The wood of *Salix lasiandra* is light, soft, brittle, and not strong; it contains numerous obscure medullary rays, and is light brown, with thick lighter colored or often nearly white sapwood. The specific gravity of the absolutely dry wood is 0.4756, a cubic foot weighing 29.64 pounds. The specific gravity of the variety *Lyallii* is 0.4547, a cubic foot weighing 28.34 pounds. The wood of the variety *caudata* is rather darker, with light brown sapwood; its specific gravity is 0.4598, a cubic foot weighing 28.65 pounds.

Salix lancifolia, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 34, t. 2, f. 23 (*Monographia Salicum*) (not Doell) (1867); *De Candolle Prodr.* xvi. pt. ii. 206.

Salix lucida, subspec. *macrophylla*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* 32 (not *Salix macrophylla*, Kerner) (1867); *De Candolle Prodr. l. c.* 205.

Salix lasiandra, var. *lancifolia*, Bebb, *Brewer & Watson Bot. Cal.* ii. 84 (1880). — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 167. — S. P. Parish, *Zoë*, iv. 347.

[1] Sudworth, *Bull. Torrey Bot. Club*, xx. 43 (1893).

Salix pentandra, β *caudata*, Nuttall, *Sylva*, i. 61, t. 18 (1842).

Salix Fendleriana, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 115 (*Bidr. Nordam. Pilarter*) (1858); *Proc. Am. Acad.* iv. 54. — Walpers, *Ann.* v. 745.

Salix arguta, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* 32 (in part) (1867); *De Candolle Prodr. l. c.* 205 (in part).

Salix lasiandra, var. *Fendleriana*, Bebb, *l. c.* (1880); *Coulter Man. Rocky Mt. Bot.* 334. — Sargent, *l. c.*

[2] Macoun, *Cat. Can. Pl.* 459.

[3] *Salix lasiandra* has recently been found on the banks of Hatwai Creek, Nez Perces County, Idaho, and the variety *Lyallii* near Thompson's Falls, Montana, far from other recorded stations of these trees (Holzinger, *Contrib. U. S. Nat. Herb.* iii. 251).

EXPLANATION OF THE PLATES.

PLATE CCCCLXIX. SALIX LASIANDRA.

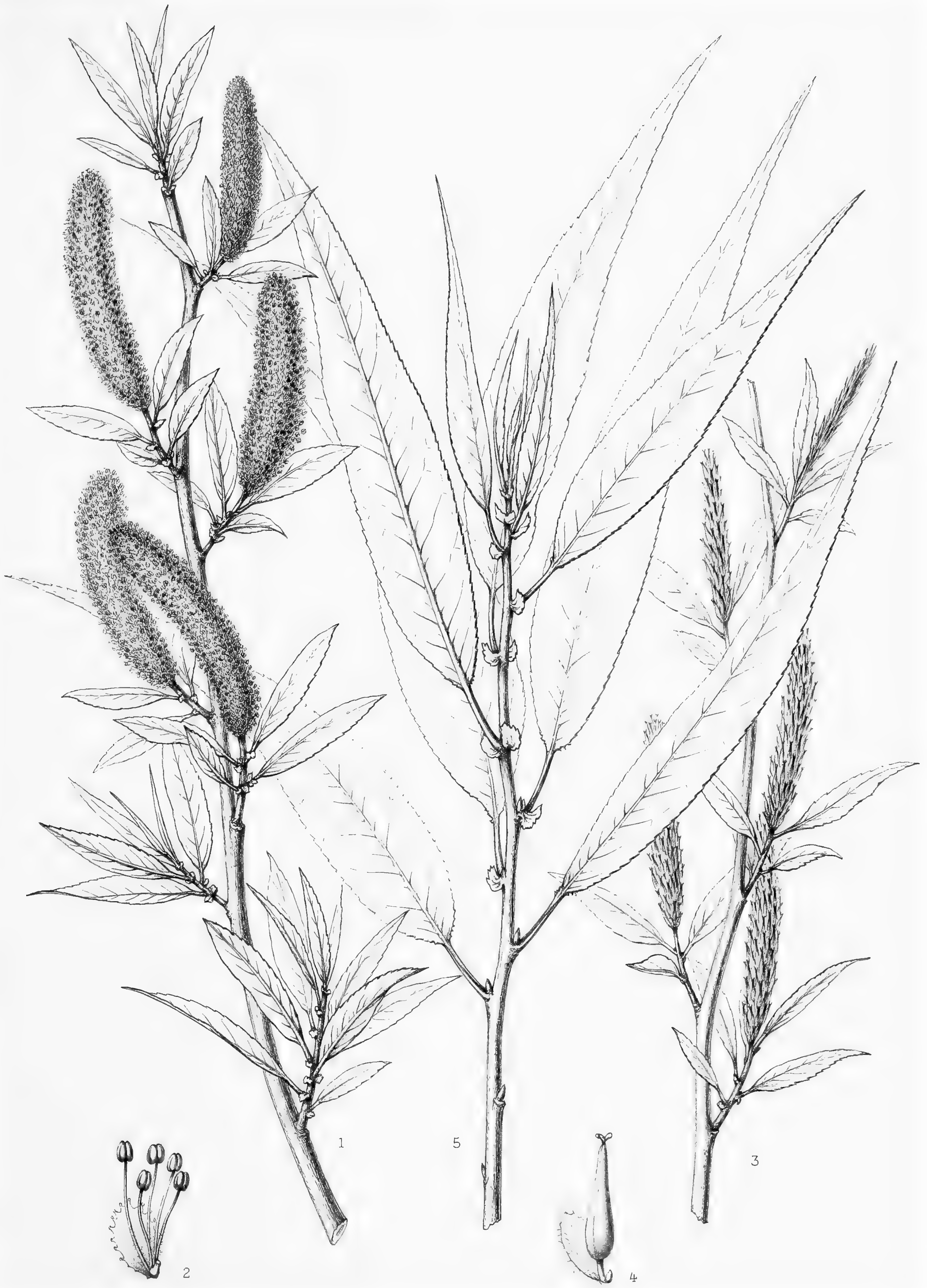
1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A summer branch, natural size.

PLATE CCCCLXX. SALIX LASIANDRA, var. LYALLII.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A leaf with its stipules, natural size.
8. A winter branch, natural size.

PLATE CCCCLXXI. SALIX LASIANDRA, var. CAUDATA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A sterile branch, natural size.
8. A winter branch, natural size.



C.E.Faxon del. *Rapine sc.*

SALIX LASIANDRA, Benth.

A.Riocreux direx.t *Imp. J.Taneur, Paris.*

C.E.Faxon del. *Himely sc.*

SALIX LASIANDRA, var. LYALLII, Sarg.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*

C.E.Faxon del. *Rapine sc.*

SALIX LASIANDRA, var. CAUDATA, Sudw

A.Riocreux direx.t *Imp. J.Taneur, Paris.*

SALIX BONPLANDIANA.

Willow.

LEAVES linear-lanceolate or oblong-lanceolate, often falcate, silvery white on the lower surface, persistent during the winter.

Salix Bonplandiana, Humboldt, Bonpland & Kunth, *Nov. Gen. et Spec.* ii. 24, t. 101, 102 (1817). — Kunth, *Syn. Pl. Æquin.* i. 365. — Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 610. — Dietrich, *Syn.* v. 419. — Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 18, t. 1, f. 14 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 200. — Hemsley, *Bot. Biol. Am. Cent.* iii. 179. — Bebb, *Garden and Forest*, viii. 364.

Salix pallida, Humboldt, Bonpland & Kunth, *Nov. Gen. et Spec.* ii. 25 (1817). — Kunth, *Syn. Pl. Æquin.* i. 366.

Salix Bonplandiana, subspec. **pallida**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 18 (*Monographia Salicum*) (1867).

Salix Bonplandiana, *β* **pallida**, Andersson, *De Candolle Prodr.* xvi. pt. ii. 200 (1868). — Hemsley, *Bot. Biol. Am. Cent.* iii. 179.

In the United States a tree rarely more than thirty feet in height, with a trunk twelve or fifteen inches in diameter, and rather slender erect and spreading branches, often pendulous at the extremities, which form a broad round-topped head. The bark of the trunk is from one half to three quarters of an inch in thickness, dark brown or nearly black, and deeply divided by narrow fissures into broad flat ridges which separate on the surface into closely appressed scales. The branchlets are slender, glabrous, and marked with occasional pale lenticels, light yellow at first, light or dark red-brown and lustrous at the end of their first season, and paler and orange-brown in their second year. The buds are narrowly ovate, long-pointed, more or less falcate, bright red-brown, lustrous, and nearly a quarter of an inch in length. The leaves are involute in the bud, linear-lanceolate or oblong-lanceolate, gradually narrowed and often unequal at the wedge-shaped base, acuminate at the apex with long slender points, and obscurely serrate with minute glandular teeth or entire with slightly revolute margins; they are thick and firm in texture, reticulate-venulose, glabrous, yellow-green and lustrous on the upper surface, silvery white on the lower, from four to six inches long and from one half to three quarters of an inch wide, with broad yellow midribs and slender arcuate primary veins conspicuous on the upper side; they are borne on stout reddish grooved petioles, and, beginning to fall irregularly during the winter, do not entirely disappear until after the expansion of the flowers in February; those at the base of the shoot are scale-like, obovate, and coated with rufous silky hairs, and fall soon after the opening of the bud, when they are not more than an inch long. The stipules are ovate, rounded, slightly undulate, thin and scarious, puberulous, from an eighth to a quarter of an inch broad, and often persistent during the summer. The aments are short-stalked and erect on leafy branches, with small often deciduous leaves which fall from those of the pistillate tree before the fruit ripens; they are slender and cylindrical, and on the staminate plant are from an inch to an inch and a half in length and somewhat longer than those of the pistillate plant; their scales are broadly obovate, rounded at the apex, light yellow, villous on the outer face and glabrous or slightly hairy above the middle on the inner face. The stamens are usually three in number, with free filaments slightly hairy at the base only. The ovary is slender, oblong-conical, glabrous, and crowned with two nearly sessile much thickened club-shaped stigmas, the short stalk being surrounded by the large irregular cup-shaped glandular disk. The capsule is ovate-conical, rounded at the base, rather long-stalked, and light reddish yellow.

Salix Bonplandiana is widely distributed through central and southern Mexico, and in Arizona

inhabits the banks of a stream in the Sabino Cañon on the southern slope of the Santa Catalina Mountains,[1] and is not uncommon in the cañons of the Chericahua and Huachuca Mountains.

The wood of *Salix Bonplandiana* has not been examined scientifically.

A representative of the tropical Willows, *Salix Bonplandiana* is the only species that has been found in the United States with leaves which do not fall in the autumn.[2]

[1] In February, 1894, *Salix Bonplandiana* was discovered in Sabino Cañon about fifteen miles from Tucson, Arizona, by W. M. Canby, J. W. Toumey, and C. S. Sargent.

[2] The cup-shaped glandular disk of the pistillate flower, which is not represented in Andersson's figure of this species (*Svensk. Vetensk. Akad. Handl.* ser. 4, vi. t. 1, f. 14 [*Monographia Salicum*]), is well developed in the specimens from Sabino Cañon which we have been able to examine; and among the Willows of the United States *Salix Bonplandiana* is the only species with a cup-like disk.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXII. SALIX BONPLANDIANA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower, enlarged.
3. Scale of a staminate flower, rear view, enlarged.
4. A flowering branch of the pistillate tree, natural size.
5. A pistillate flower with its scale, front view, enlarged.
6. A pistillate flower with its scale, side view, enlarged.
7. A pistil, enlarged.
8. A fruiting branch, natural size.
9. A capsule, enlarged.
10. A summer branch, natural size.

C.E. Faxon del. Himely sc.

SALIX BONPLANDIANA, H.B.K.

A. Riocreux direx.t Imp. J. Taneur, Paris.

SALIX LUCIDA.

Shining Willow.

LEAVES lanceolate, long-pointed, coriaceous, dark green and lustrous, their petioles glandular.

Salix lucida, Muehlenberg, *Neue Schrift. Gesell. Nat. Fr. Berlin*, iv. 239, t. 6, f. 7 (1803); *Konig & Sims Ann. Bot.* ii. 66, t. 5, f. 7. — Willdenow, *Spec.* iv. pt. ii. 667. — Persoon, *Syn.* ii. 600. — Wade, *Salices*, 91. — Michaux f. *Hist. Arb. Am.* iii. 327, t. 5, f. 3. — Pursh, *Fl. Am. Sept.* ii. 615. — Poiret, *Lam. Dict.* Suppl. v. 57. — Nuttall, *Gen.* ii. 231. — Sprengel, *Syst.* i. 99. — Forbes, *Salict. Woburn.* 63, t. — Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 625. — Loudon, *Arb. Brit.* iii. 1504, f. 1301. — Hooker, *Fl. Bor.-Am.* ii. 148. — Barratt, *Sal. Amer.* No. 17. — Torrey, *Fl. N. Y.* ii. 208, t. 119. — Emerson, *Trees Mass.* 267; ed. 2, i. 310, t. — Dietrich, *Syn.* v. 418. — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 115 (*Bidr. Nordam. Pilarter*) (excl. var. *angustifolia lasiandra*); *Proc. Am. Acad.* iv. 54 (excl. *angustifolia*, forma *lasiandra*); *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 30, t. 2, f. 21 (*Monographia Salicum*) (excl. var. *angustifolia* and var. *macrophylla*); *De Candolle Prodr.* xvi. pt. ii. 205. — Dudley, *Bull. Cornell University*, ii. 87 (*Cayuga Fl.*). — Bebb, *Watson & Coulter Gray's Man.* ed. 6, 481. — Dippel, *Handb. Laubholzk.* ii. 215, f. 108. — Koehne, *Deutsche Dendr.* 90.

Salix lucida latifolia, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 115 (*Bidr. Nordam. Pilarter*) (1858); *Proc. Am. Acad.* iv. 54; *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 31 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 205.

Salix lucida ovatifolia, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 115 (*Bidr. Nordam. Pilater*) (1858); *Proc. Am. Acad.* iv. 54; *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 31 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 205.

Salix lucida pilosa, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 115 (*Bidr. Nordam. Pilarter*) (1858).

Salix lucida, var. **angustifolia**, forma **pilosa**, Andersson, *Proc. Am. Acad.* iv. 54 (1858).

Salix lucida rigida, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 32 (*Monographia Salicum*) (1867).

Salix lucida tenuis, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 32 (*Monographia Salicum*) (1867).

A bushy tree, occasionally twenty or twenty-five feet in height, with a short trunk six or eight inches in diameter, and erect branches which form a broad round-topped symmetrical head; or usually smaller and shrubby in habit. The bark of the trunk is thin, dark brown, slightly tinged with red, and generally smooth. The branchlets are stout and glabrous, and in their first season are dark orange-color and lustrous, becoming darker and more or less tinged with red during their second year. The buds are narrowly ovate, acute, light orange-brown, lustrous, and about a quarter of an inch in length. The leaves are involute in the bud, lanceolate, gradually or abruptly narrowed and wedge-shaped or rounded at the base, acute at the apex with long tapering often falcate points, and finely serrate with glandular teeth; when they unfold they are covered with scattered pale caducous hairs, and at maturity are coriaceous, smooth and lustrous, dark green on the upper surface, paler on the lower, from three to five inches long and from an inch to an inch and a half wide, with broad yellow midribs raised and rounded on the upper side, slender primary veins arcuate and united within the margins and connected by reticulate cross veinlets, and stout yellow puberulous petioles grooved above, glandular at the apex with several dark or yellow conspicuous glands, and from one quarter to one half of an inch in length; the first leaves are oblong, acute and coated with pale hairs, and usually fall when not more than three quarters of an inch long. The stipules are nearly semicircular, glandular-serrate, membranaceous, and from one eighth to one quarter of an inch broad, and often do not fall until the end of the summer. The aments are erect and tomentose, and are borne on stout puberulous peduncles terminal on short leafy branchlets whose leaves usually vary from an inch to an inch and a half in length; those of the staminate plant are oblong-cylindrical, densely flowered, about an inch long and half an inch broad, and those of the pistillate are slender, elongated, from an inch and a half to two inches in length,

becoming three or four inches long when the fruit ripens, and often persistent until late in the season; the scales are oblong or obovate, rounded, entire, erose or dentate at the apex, light yellow, nearly glabrous or coated on the back with pale hairs, often ciliate on the margins, and deciduous before the ripening of the fruit. The stamens are usually five in number, with elongated free filaments slightly hairy at the very base. The ovary is narrowly cylindrical, elongated, glabrous, long-stalked, and crowned with nearly sessile emarginate stigmas. The capsule is cylindrical, about one third of an inch long, lustrous, and rigid.

Salix lucida, which inhabits the banks of streams and swamps, and is very abundant at the north, is distributed from Newfoundland [1] to the shores of Hudson's Bay, northwestward to those of Great Bear Lake and the valley of the Mackenzie River,[2] and westward in British America to the eastern base of the Rocky Mountains; it ranges in the United States southward to southern Pennsylvania,[3] where it is rare, and westward to eastern Nebraska.[4]

The wood of *Salix lucida* has not been examined.

The large dark green lustrous leaves and showy staminate aments of the Shining Willow make it a desirable garden plant.

[1] In August, 1894, *Salix lucida* was collected on the banks of the Exploits River, Newfoundland, by B. L. Robinson and H. Schrenk.

[2] Provancher, *Flore Canadienne*, ii. 529. — Macoun, *Cat. Can. Pl.* 450.

[3] Darlington, *Fl. Cestr.* ed. 3, 280.

[4] Bessey, *Rep. Nebraska State Board Agric.* 1894, 103.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXIII. SALIX LUCIDA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A sterile branch, natural size.

C.E.Faxon del. *Himely sc.*

SALIX LUCIDA, Muehl.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*

SALIX FLUVIATILIS.

Sand-bar Willow.

LEAVES linear-lanceolate, usually green on both surfaces.

Salix fluviatilis, Nuttall, *Sylva*, i. 73 (1842). — Sargent, *Garden and Forest*, viii. 463.

Salix longifolia, Muehlenberg, *Neue Schrift. Gesell. Nat. Fr. Berlin*, iv. 238, t. 6, f. 6 (not Lamarck) (1803); *Konig & Sims Ann. Bot.* ii. 66, t. 5, f. 6. — Willdenow, *Spec.* iv. pt. ii. 670. — Persoon, *Syn.* ii. 600. — Wade, *Salices*, 119. — Pursh, *Fl. Am. Sept.* ii. 613. — Nuttall, *Gen.* ii. 231. — Torrey, *Ann. Lyc. N. Y.* ii. 248; *Nicollet's Rep.* 160; *Fl. N. Y.* ii. 209; *Frémont's Rep.* 97; *Emory's Rep.* 412; *Sitgreaves' Rep.* 172; *Bot. Mex. Bound. Surv.* 204. — Hooker, *Fl. Bor.-Am.* ii. 149. — Barratt, *Sal. Amer.* No. 23. — Dietrich, *Syn.* v. 420. — Parry, *Owen's Rep.* 618. — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 116 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 55; *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 54, t. 4, f. 35 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 214. — Walpers, *Ann.* v. 745. — Watson, *King's Rep.* v. 324. — Bebb, *Rothrock Wheeler's Rep.* vi. 240; *Brewer & Watson Bot. Cal.* ii. 84; *Coulter Man. Rocky Mt. Bot.* 335; *Watson & Coulter Gray's Man.* ed. 6, 482. — Ward, *Bull. U. S. Nat. Mus.* No. 22, 116 (*Fl. Washington*). — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 168. — Dudley, *Bull. Cornell University*, ii. 89 (*Cayuga Fl.*). — Dippel, *Handb. Laubholzk.* ii. 246, f. 115. — Koehne, *Deutsche Dendr.* 91. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 419 (*Man. Pl. W. Texas*). — Coville, *Contrib. U. S. Nat. Herb.* iv. 199 (*Bot. Death Valley Exped.*). — Greene, *Man. Bot. Bay Region*, 299. — Holzinger, *Contrib. U. S. Nat. Herb.* iii. 251.

Salix rubra, Richardson, *Franklin Jour.* Appx. No. 7, 765 (not Hudson) (1823).

Salix longifolia pedicellata, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 55, t. 4, f. 35 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 214. — Macoun, *Rep. Geolog. Surv. Can.* 1875–76, 210.

Salix Nevadensis, Watson, *Am. Nat.* vii. 302 (1873); *Cat. Pl. Wheeler*, 17.

A tree, usually about twenty feet in height, with a trunk only a few inches in diameter, and short slender erect branches, spreading by stoloniferous roots into broad thickets; or occasionally sixty or seventy feet in height, with a trunk two feet in diameter; or often a shrub not more than five or six feet high. The bark of the trunk is from an eighth to a quarter of an inch in thickness, smooth, dark brown slightly tinged with red, and covered with small closely appressed irregularly shaped scales. The branchlets are slender, glabrous, light or dark orange-color or purplish red, and rather darker after their first season. The winter-buds are narrowly ovate, acute, chestnut-brown, and about an eighth of an inch in length. The leaves are involute in the bud, linear-lanceolate, often somewhat falcate, gradually narrowed at both ends, long-pointed, and dentate with small remote spreading callous gland-tipped teeth; when they unfold they are coated on the lower surface with soft lustrous silky caducous hairs, and at maturity are thin, glabrous, light yellow-green, darker on the upper than on the lower surface, from two to six inches long and from one eighth to one third of an inch wide, with yellow midribs raised and rounded on the upper side, slender arcuate primary veins, conspicuous reticulate veinlets, and stout grooved petioles from an eighth to a quarter of an inch in length. The stipules are ovate-lanceolate, foliaceous, about a quarter of an inch long, and deciduous. The aments are borne on stout peduncles covered with soft silky pale pubescence; their scales are obovate-oblong, entire, erose or sparingly dentate above the middle, light yellow-green, densely villous on the outer surface and slightly hairy on the inner; on the staminate plant they are oblong-cylindrical, about an inch long and a third of an inch broad, and terminal and axillary on short or elongated lateral branches whose leaves are often reduced to ovate acute scarious pubescent deciduous scales about a third of an inch long, the flowers of the terminal ament opening before those of the axillary aments; on the pistillate plant the aments are cylindrical, elongated, from two to three inches long, about a quarter of an inch broad, and terminal on leafy branches. The stamens are two in number, with free filaments slightly hairy at the very base.

The ovary is oblong-cylindrical, acute, short-stalked, glabrous or covered with silky pubescence, and crowned with the large sessile deeply lobed stigmas. The capsule is light red-brown, glabrous or villous, and about a quarter of an inch long.

Salix fluviatilis is distributed from the shores of Lake St. John[1] and the Island of Orleans in the province of Quebec southward through western New England to the valley of the Potomac River; it ranges northwestward to points within the Arctic Circle in the valley of the Mackenzie River, across the continent to British Columbia[2] and California, and southward through the basin of the Mississippi River to northern Mexico and Lower California.[3] An inhabitant of river banks, the Sand-bar Willow is the first tree or shrub in all the northern interior region of the continent which springs up on the newly formed sand-bars and banks of rivers, consolidating them with its long rigid roots and helping to build them up with the mud retained on the surface by its flexible crowded stems, and so prepares them for the growth of the Poplars which line the banks of western and northern streams. Exceedingly common in the basin of the Mississippi River, where it probably reaches its largest size in southern Indiana and Illinois,[4] *Salix fluviatilis* gradually becomes smaller and more rare as it approaches the Atlantic seaboard; it is abundant in all the prairie regions of British America and lines the banks of streams flowing eastward through the central plateau of the continent, where it is the commonest Willow, as it is in the arid regions immediately west of the Rocky Mountains; in Texas it is abundant as far west as the valley of the Pecos River, but is rare in the territory south of the Colorado plateau, in New Mexico and Arizona. It reappears west of the Colorado Desert in southern California, and is not rare in all the region adjacent to the Pacific coast from Lower California to northern British Columbia.

Salix fluviatilis, var. *argyrophylla*,[5] which is distributed from western Texas to northern California, has leaves and capsules clothed with lustrous silky pale tomentum; and in the variety *exigua*[6] of the same region the leaves are linear, two or three inches long and often not more than a third of an inch wide.

The wood of *Salix fluviatilis* is light, soft, and very close-grained; it is light brown tinged with red, with thin light brown sapwood, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4930, a cubic foot weighing 30.72 pounds. The wood of the variety *exigua* is rather heavier and darker in color, with a specific gravity of 0.5342, a cubic foot weighing 33.29 pounds.

[1] *Salix fluviatilis* was collected in August, 1894, by Mr. J. G. Jack on the shores of Lake St. John.

[2] Provancher, *Flore Canadienne*, ii. 531. — Macoun, *Cat. Can. Pl.* 450.

[3] Brandegee, *Proc. Cal. Acad.* ser. 2, ii. 205 (*Pl. Baja Cal.*).

[4] Ridgway, *Proc. U. S. Nat. Mus.* xvii. 414.

[5] *Salix fluviatilis*, var. *argyrophylla*.

Salix argyrophylla, Nuttall, *Sylva*, i. 71, t. 20 (1842).

Salix longifolia argyrophylla, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 55 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 214. — Watson, *King's Rep.* v. 324. — Bebb, *Rothrock Pl. Wheeler*, 50; *Brewer & Watson Bot. Cal.* ii. 85. — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* No. 4, 128. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 168. — Macoun, *Cat. Can. Pl.* 450. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 419 (*Man. Pl. W. Texas*). — Coville, *Contrib. U. S. Nat. Herb.* iv. 199 (*Bot. Death Valley Exped.*).

Salix longifolia opaca, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* (1867).

[6] *Salix fluviatilis*, var. *exigua*.

Salix exigua, Nuttall, *Sylva*, i. 75 (1842).

Salix longifolia angustissima, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 116 (*Bidr. Nordam. Pilarter*) (1858); *Proc. Am. Acad.* iv. 56.

Salix longifolia, var. *exigua*, Bebb, *Brewer & Watson l. c.* (1880). — Sargent, *l. c.* — Coulter, *l. c.* — Coville, *l. c.*

EXPLANATION OF THE PLATE.

Plate CCCCLXXIV. Salix fluviatilis.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule with opening carpels, enlarged.
7. Portion of a branch with base of a leaf and stipule, natural size.
8. A winter branch, natural size.

C.E. Faxon del.

Rapine sc.

SALIX FLUVIATILIS, Nutt.

A. Riocreux direct.

Imp. J. Taneur, Paris.

SALIX SESSILIFOLIA.

Willow.

LEAVES lanceolate or linear-lanceolate, villous on the lower surface with lustrous pale hairs.

Salix sessilifolia, Nuttall, *Sylva*, i. 68 (1842). — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 116 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 56; *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 55, t. 4, f. 36 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 214. — Walpers, *Ann.* v. 746. — Bebb, *Brewer & Watson Bot. Cal.* ii. 85. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 168. — Mayr, *Wald. Nordam.* 288.

Salix Hindsiana, Bentham, *Pl. Hartweg.* 335 (1857). — Torrey, *Pacific R. R. Rep.* iv. pt. v. 138. — Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 56, t. 4, f. 37 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 215. — Walpers, *Ann.* v. 746.

Salix sessilifolia Hindsiana, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 117 (*Bidr. Nordam. Pilarter*) (1858); *Proc. Am. Acad.* iv. 56. — Bebb, *Brewer & Watson Bot. Cal.* ii. 85. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 169.

Salix Hindsiana tenuifolia, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 56 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 215.

Salix sessilifolia, β villosa, Andersson, *De Candolle Prodr.* xvi. pt. ii. 215 (1868).

A tree, occasionally thirty feet in height, with a trunk a foot in diameter, and slender erect branches forming a narrow head; or often, especially at the south, reduced to a tall or a low shrub. The bark of the trunk is nearly half an inch in thickness, dark brown, slightly fissured, and covered with thick irregular closely appressed scales. The branchlets are slender, coated at first with hoary pubescence which gradually disappears during the summer, and are afterward rather reddish brown. The buds are narrow, ovate, acute, and nearly an eighth of an inch long. The leaves are involute in the bud, lanceolate or linear-lanceolate, often slightly falcate, narrowed at both ends, long-pointed at the apex, and entire or dentate above the middle with spreading remote rigid glandular teeth; when they unfold they are covered with hoary tomentum, which is thickest below, and at maturity are light yellow-green, glabrous or puberulous on the upper surface, villous on the lower with silky lustrous white hairs, from an inch and a half to five inches long and from one twelfth to one quarter of an inch wide, with yellow midribs, obscure arcuate veins, and stout pubescent petioles rarely more than an eighth of an inch in length. The stipules are acute, hoary-pubescent, about a quarter of an inch long, and deciduous. The aments are cylindrical, densely flowered, terminal and axillary on leafy branches, about three inches in length on the pistillate plant and hardly more than half as long but broader on the staminate; their scales are oblong-obovate, pale yellow-green and villous on the back with pale silky hairs, those of the staminate being rather broader than those of the pistillate ament, and erose or denticulate above the middle. The stamens are two in number, with free glabrous filaments. The ovary is oblong-cylindrical, short-stalked, villous, and crowned with the nearly sessile bifid stigma. The capsule is elongated, cylindrical, short-stalked, bright red brown, more or less villous, and about a quarter of an inch in length.[1]

Salix sessilifolia inhabits the banks of streams, and is distributed from the shores of Puget Sound

[1] *Salix sessilifolia*, which is still very imperfectly known, is here treated as a species, although it is not always easy to distinguish it from the variety *argyrophylla* of *Salix fluviatilis*, and it might perhaps with equal reason be considered one of the numerous forms of that variable species. The linear lobes of the stigmas which are sometimes found in *Salix sessilifolia* and have been used to distinguish it have little specific significance and cannot be relied upon. Indeed, constant characters by means of which the purely American and well marked group of Longifloræ can be satisfactorily divided into species cannot be defined, and, although for the sake of convenience the principal forms are usually considered specifically distinct, they can with equal reason be grouped under a single species. (See Bebb, *Bot. Gazette*, xvi. 103.)

southward through western Washington and Oregon, where it appears to have been discovered by Thomas Nuttall [1] on the Willamette River, and along the western slopes and foothills of the California Sierras to the valleys and foothills of the coast ranges of the southwestern part of the state, where it is one of the commonest Willows.[2]

The wood of *Salix sessilifolia* is light, soft, and close-grained; it contains thin obscure medullary rays, and is light red, with thin nearly white sapwood. The specific gravity of the wood of a tree from the region adjoining the mouth of the Willamette River in Oregon is 0.4397, a cubic foot weighing 27.40 pounds.

[1] See ii. 34.

[2] S. B. Parish, *Zoë*, iv. 347.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXV. SALIX SESSILIFOLIA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.

C.E. Faxon del.

Migneaux sc.

SALIX SESSILIFOLIA, Nutt.

A. Riocreux direct.

Imp. J. Taneur, Paris.

SALIX TAXIFOLIA.

Willow.

LEAVES linear-lanceolate, pale gray-green and puberulous.

Salix taxifolia, Humboldt, Bonpland & Kunth, *Nov. Gen. et Spec.* ii. 22 (1817). — Kunth, *Syn. Pl. Æquin.* i. 364. — Dietrich, *Syn.* v. 421. — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 117 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 56; *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 57 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 215. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 419 (*Man. Pl. W. Texas*). — Bebb, *Garden and Forest*, viii. 372.

Salix microphylla, Schlechtendal & Chamisso, *Linnæa*, vi. 354 (1831). — Hooker & Arnott, *Bot. Voy. Beechey*, 310, t. 70.

Salix taxifolia, var. α **sericocarpa**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 57 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 215.

Salix taxifolia, var. β **leiocarpa**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 215 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 215.

In Arizona a tree often forty or fifty feet in height, with a trunk eighteen inches in diameter, a broad open head, and lower branches long, drooping, and slender at the extremities. The bark of the trunk is from three quarters of an inch to an inch in thickness, light gray-brown, and divided by deep fissures into broad flat ridges covered with minute closely appressed scales. The branchlets are slender, clothed with hoary tomentum which does not disappear until the end of their first season, when they become light reddish or purplish brown and much roughened by the elevated persistent leaf-scars. The buds are ovate, acute, dark chestnut-brown, puberulous, about a sixteenth of an inch in length and nearly as broad as long. The leaves are involute in the bud, subdistichous, linear-lanceolate, narrowed at both ends, acute, slightly falcate and mucronate at the apex, and entire or rarely obscurely dentate above the middle with occasional minute teeth; when they unfold they are coated with long slender white soft hairs which gradually disappear, and at maturity they are pale gray-green, slightly puberulous on both surfaces, from one third of an inch to an inch and one third long, and from one twelfth to one eighth of an inch wide, with slender midribs, thin arcuate veins, thickened and slightly revolute margins, and stout puberulous petioles rarely one twelfth of an inch in length. The stipules are ovate, acute, scarious, minute, and caducous. The aments, which are oblong-cylindrical or subglobose, densely flowered, and from one quarter to one half of an inch long, are terminal, or terminal and axillary on the staminate plant, and borne on short leafy branches, and in Arizona expand in May, the lateral aments developing later than the terminal; their scales are oblong or obovate, rounded or acute and sometimes apiculate at the apex, coated more or less densely on the outer surface with hoary tomentum, and pubescent or glabrous on the inner. The stamens are two in number, with free filaments hairy below the middle. The ovary is ovate-conical, villous with pale hairs, short-stalked or subsessile, and crowned by the nearly sessile deeply emarginate stigmas. The capsule is cylindrical, long-pointed, bright red-brown, more or less villous, short-stalked, and about a quarter of an inch in length.

In the United States *Salix taxifolia* was first collected in 1849 by Mr. Charles Wright near El Paso, Texas.[1] It was discovered in May, 1883, by Mr. C. G. Pringle[2] in the neighborhood of

[1] No. 669.

[2] Cyrus Guernsey Pringle was born on the 6th of May, 1838, on a farm in Charlotte, Vermont, near the shore of Lake Champlain. His father was of sturdy Scotch stock and his mother of Puritan descent. The necessity of aiding his mother and younger brothers after the early death of his father compelled him to leave college before graduation and to assume the care of the farm, upon which for many years he practiced horticulture with conspicuous success, and, with other flowers and fruits, cultivated a collection of Lilies which has probably never been equaled in the United States. From 1868 to 1878 Mr. Pringle devoted himself principally to the study and practice of the hybridization of plants, in

Tucson,[1] Arizona, and is scattered along mountain streams in southern Arizona, through Mexico to Guatemala[2] and Lower California.[3]

The wood of *Salix taxifolia* has not been examined.

which he achieved remarkable results. At this time he produced, by crossing and selection, the Snow Flake, Ruby, and Alpha potatoes, and supplied potato-breeders with seeds from which many other named varieties have been obtained ; he raised the Champion, Defiance, Superior, Green Mountain, and other varieties of wheat which have been cultivated successfully in the eastern states, California, and Australia, the Triumph and other varieties of oats, and the Conqueror and Little Gem tomatoes ; and from the crossing of Apples, Pears, Plums, Grapes, Raspberries, and other plants he obtained many interesting hybrids. Satisfied with his labors in this field, Mr. Pringle turned his attention to systematic botany, in which he had been interested from boyhood, and about 1876 commenced to make sets of the rare plants of northern New England for distribution. As a collector he was as successful as he had been in other fields of activity, and no one has ever selected and prepared specimens for the herbarium with greater intelligence and skill. In 1880 Mr. Pringle was appointed special agent of the Forestry Division of the 10th Census of the United States, and for two years explored the forests of northern New England and New York, studying their composition and resources. This duty performed, he made for the Jesup Collection of North American Woods of the American Museum of Natural History a large collection of timber specimens from some of the most inaccessible and difficult regions of Arizona, California, Oregon, and Washington. Becoming interested during this journey in the flora of Mexico, he has for the last twelve years devoted himself exclusively to its exploration. During his annual journeys, which have extended over many of the states, he has made large and unrivaled collections which have been acquired by the principal herbaria of the United States and Europe, and has discovered many undescribed genera and species. In recognition of his services to botany, Asa Gray dedicated to him the genus *Pringleophytum*, an herb of the Acanthus family which he found in 1884 in a region of northern Sonora, which he was the first botanist to traverse, and his name is associated with many other Mexican plants of his discovery.

[1] In Arizona *Salix taxifolia* has also been collected in cañons of the Santa Catalina Mountains by C. G. Pringle, and in 1894 in cañons of the Santa Rita and Swissholm Mountains by Professor J. W. Toumey.

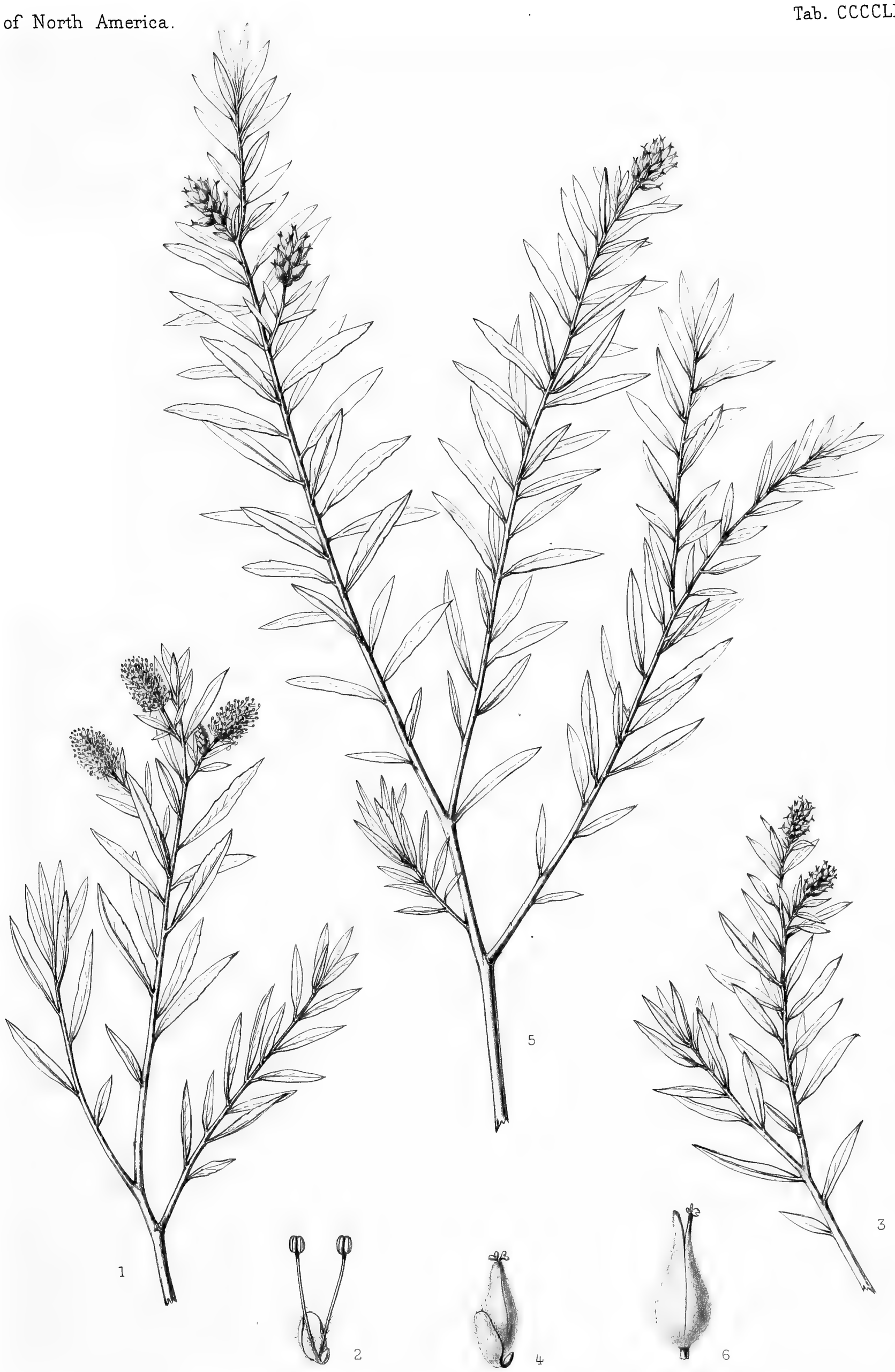
[2] Hemsley, *Bot. Biol. Am. Cent.* iii. 180.

[3] Brandegee, *Zoë*, iv. 406.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXVI. SALIX TAXIFOLIA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.



C.E.Faxon del.

Himely sc.

SALIX TAXIFOLIA, H B K.

A.Riocreux direct.

Imp. J.Taneur, Paris.

SALIX BEBBIANA.

Willow.

LEAVES oblong-obovate or oblong-elliptical, conspicuously reticulate-venulose, dull green on the upper surface, glaucous or silvery white and pubescent on the lower.

Salix Bebbiana, Sargent, *Garden and Forest*, viii. 463 (1895).

Salix rostrata, Richardson, *Franklin Jour.* Appx. No. 7, 765 (not Thuillier) (1823). — Sprengel, *Syst.* iv. pt. ii. 20. — Hooker, *Fl. Bor.-Am.* ii. 147. — Barratt, *Sal. Amer.* No. 25. — Torrey, *Fl. N. Y.* ii. 211. — Emerson, *Trees Mass.* 274; ed. 2, i. 302, t. — Dudley, *Bull. Cornell University*, ii. 89 (*Cayuga Fl.*). — Bebb, *Rothrock Wheeler's Rep.* vi. 240; *Coulter Man. Rocky Mt. Bot.* 337; *Watson & Coulter Gray's Man.* ed. 6, 482.

Salix vagans, b **occidentalis**, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 122 (*Bidr. Nordam. Pilarter*) (1858); *Proc. Am. Acad.* iv. 62.

Salix vagans, subspec. **rostrata**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 87 (*Monographia Salicum*) (1867).

Salix vagans, *β* **rostrata**, Andersson, *De Candolle Prodr.* xvi. pt. ii. 227 (1868).

A bushy tree, occasionally twenty-five feet in height, with a short trunk six or eight inches in diameter, and stout ascending branches which form a broad round head; or usually much smaller and often shrubby in habit. The bark of the trunk is thin, reddish or olive green, or gray tinged with red, and slightly divided by shallow fissures into appressed plate-like scales. The branchlets are slender and coated at first with hoary tomentum which gradually disappears; during their first winter they vary from reddish purple to dark orange-brown and are marked by scattered raised lenticels and roughened by the conspicuous elevated leaf-scars, and in their second year grow lighter and reddish brown. The buds are oblong, gradually narrowed and rounded at the apex, full and rounded on the back, with thin margins, flattened on the inner face by pressure against the stem, bright light chestnut-brown, and nearly a quarter of an inch long. The leaves are conduplicate in the bud, oblong-obovate, oblong-elliptical or lanceolate, gradually narrowed and wedge-shaped or rounded at the base, acuminate and short-pointed or acute at the apex, and remotely and irregularly serrate, usually only above the middle, with small incurved glandular teeth, or rarely entire; when they unfold they are thin, pale gray-green, glabrous or villous and often tinged with red on the upper surface, and coated on the lower with pale tomentum or pubescence; and at maturity they are thick and firm in texture, dull green and glabrous or puberulous on the upper surface, and on the lower pale blue or silvery white and coated with pale or rufous pubescence, especially along the midribs, veins, and conspicuous reticulate veinlets which are impressed on the upper side, from one to three inches long and from half an inch to an inch wide, with slender often reddish pubescent petioles from one quarter to one half of an inch in length. The stipules are foliaceous, semicordate, acute, glandular-dentate, sometimes nearly half an inch long on vigorous shoots, and deciduous. The aments appear with the unfolding leaves, and are erect and terminal on short leafy branches with small and often scale-like leaves; their scales are ovate or oblong, rounded at the apex, broader on the staminate than on the pistillate plant, yellow below, rose-color at the apex, coated with long pale silky hairs, and persistent under the fruit; the aments of the staminate plant are cylindrical-obovate, narrowed at the base, from three quarters of an inch to an inch long and from one half to three quarters of an inch broad, densely flowered, silvery white before and pale yellow after the opening of the flowers; the aments of the pistillate plant are oblong-cylindrical, loosely flowered, and about an inch in length. The stamens are two in number, with free glabrous filaments. The ovary is cylindrical, villous with long silky white hairs, long-stalked, gradually narrowed at the apex, and crowned

by the broad sessile entire or emarginate spreading yellow stigmas. The capsule is elongated-cylindrical, gradually narrowed into a long thin beak and raised on a slender stalk, sometimes half an inch long, much longer than the persistent scarious slightly villous scale.

Salix Bebbiana inhabits the borders of streams, swamps, and lakes, dry hillsides, open woods and forest margins, usually selecting moist rich soil. In British America, where it is one of the commonest and most generally distributed Willows, it ranges from the valley of the lower St. Lawrence River to the shores of Hudson's Bay, the valley of the Mackenzie River within the Arctic Circle, and the coast ranges of British Columbia,[1] forming, in the region west of Hudson's Bay, almost impenetrable thickets with twisted and often inclining stems twenty or thirty feet high.[2] Common in all the northern states, it ranges southward to Pennsylvania and westward to Minnesota, and is scattered through the Rocky Mountain region from western Idaho[3] and northern Montana to the Black Hills of Dakota,[4] and western Nebraska,[5] and southward through Colorado, where as a low shrub it ascends to elevations of ten thousand feet above the sea, to northern Arizona.[6]

The wood of *Salix Bebbiana* has not been examined scientifically.

The specific name commemorates the labors of the most accomplished American salicologist, Michael Schuck Bebb.[7]

[1] Provancher, *Fl. Canadienne*, ii. 530.—Macoun, *Cat. Can. Pl.* 453.

[2] Richardson, *Arctic Searching Exped.* ii. 313.

[3] Holzinger, *Contrib. U. S. Nat. Herb.* iii. 251.

[4] Williams, *Bull.* No. 43 *South Dakota Agric. College*, 107.

[5] Bessey, *Rep. Nebraska State Board Agric.* 1894, 103.

[6] In September, 1895, *Salix Bebbiana* was found by J. W. Toumey and C. S. Sargent on the northern slopes of the San Francisco Mountains in Arizona at an elevation of eight thousand five hundred feet, forming in moist ground great shrubs with many spreading stems fifteen or twenty feet high.

[7] Michael Schuck Bebb (December 23, 1833–December 5, 1895) was born in Butler County in southwestern Ohio, where his grandfather, Edward Bebb, a Welshman, had been one of the first white settlers in the fertile Miami valley. His father was a teacher and then a successful lawyer in Hamilton, the county town to which the family removed in 1835, and in 1846 was elected governor of Ohio. The well-kept garden surrounding the Bebb mansion in Hamilton was stocked with flowering plants and fruit-trees, and here, while still a boy, the future botanist acquired his first knowledge of plants, and, without the aid of a text-book, learned with effort the rudiments of the science from a copy of Torrey's report upon the *Flora of the State of New York*, which had been sent to his father with other New York State reports by a political friend. In 1850 the family moved to a large tract of land which Governor Bebb had purchased in the Rock River valley in northern Illinois, near the present town of Fountaindale. Mr. Bebb's love of botany was then increased by the acquisition of a few more botanical books and by an acquaintance with Dr. George Vasey, which began five or six years later, and was still further stimulated by a visit to New England, where he met several men of science. During the War of Secession he was a clerk in the Pension Office in Washington, and then, returning to Illinois, purchased the paternal homestead at Fountaindale and devoted himself to botany and especially to the study of Willows. The largest and most complete collection of these plants which has ever been made in the United States was planted at this time by Mr. Bebb, but, unfortunately, was destroyed a few years ago, when he moved to Rockford, Illinois. Since the year 1874, when he described his first Willow in *The American Naturalist*, all the collections of Willows made in North America have been studied by him; he has described the California species in Brewer & Watson's *Botany of California*, the southwestern species, gathered by Rothrock, in the sixth volume of *Wheeler's Report*, the Colorado species in Coulter's *Manual of the Botany of the Rocky Mountain Region*, and the species of the eastern states in the sixth edition of Gray's *Manual of the Botany of the Northern United States*, and has contributed to botanical journals many papers upon the American species of the genus. (See *Garden and Forest*, viii. 510.)

The specimens of Salix which are figured in this work have all been selected by Mr. Bebb, and I take this opportunity to acknowledge my great indebtedness for the advice and assistance which he has freely given me during the last fifteen years.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXVII. SALIX BEBBIANA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. Scale of a pistillate flower, enlarged.
6. Portion of a fruiting branch, natural size.
7. A capsule, enlarged.
8. A summer branch, natural size.
9. A winter branch, natural size.

C.E. Faxon del. *Rapine sc.*

SALIX BEBBIANA, Sarg.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

SALIX DISCOLOR.

Glaucous Willow.

LEAVES oblong, oblong-obovate, or lanceolate, glaucous or silvery white on the lower surface.

Salix discolor, Muehlenberg, *Neue Schrift. Gesell. Nat. Fr. Berlin*, iv. 234, t. 6, f. 1 (1803); *Konig & Sims Ann. Bot.* ii. 62, t. 5, f. 1. — Willdenow, *Spec.* iv. pt. ii. 665. — Persoon, *Syn.* ii. 599. — Wade, *Salices*, 76. — Pursh, *Fl. Am. Sept.* ii. 613. — Poiret, *Lam. Dict.* Suppl. v. 56. — Nuttall, *Gen.* ii. 231. — Elliott, *Sk.* ii. 669. — Bigelow, *Fl. Boston.* ed. 2, 364. — Sprengel, *Syst.* i. 104. — Forbes, *Salict. Woburn.* 279. — Loudon, *Arb. Brit.* iii 1530, 1630, f. 147. — Hooker, *Fl. Bor.-Am.* ii. 147. — Barratt, *Sal. Amer.* No. 3. — Torrey, *Fl. N.Y.* ii. 206. — Emerson, *Trees Mass.* 258; ed. 2, i. 296, t. — Dietrich, *Syn.* v. 419. — Darlington, *Fl. Cestr.* ed. 3, 277. — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 123 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 63; *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 83, t. 5, f. 49 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 225. — Walpers, *Ann.* v. 750. — Chapman, *Fl.* 430. — K. Koch, *Dendr.* ii. pt. i. 570. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 169. — Dudley, *Bull. Cornell University*, ii. 89 (*Cayuga Fl.*). — Watson & Coulter, *Gray's Man.* ed. 6, 482. — Dippel, *Handb. Laubholzk.* ii. 254, f. 116. — Koehne, *Deutsche Dendr.* 100.

Salix sensitiva, Barratt, *Sal. Amer.* No. 8 (1840).

A tree, rarely exceeding twenty feet in height, with a trunk about a foot in diameter, and stout ascending branches which form an open round-topped head; or more often shrubby, with numerous tall straggling stems. The bark of the trunk is a quarter of an inch in thickness, light brown tinged with red, and divided by shallow fissures into thin plate-like oblong scales which in falling disclose the dark brown inner bark. The branchlets are stout, marked with occasional orange-colored lenticels, dark reddish purple, and coated at first with pale deciduous pubescence. The buds are ovate, semiterete, flattened and acute at the apex, about three eighths of an inch long, dark reddish purple and lustrous. The leaves are convolute in the bud, oblong or oblong-obovate or rarely lanceolate, gradually narrowed at both ends, wedge-shaped at the base, acute and short-pointed at the apex, and remotely crenately serrate with minute incurved glandular teeth; when they unfold they are thin, light green often tinged with red, pubescent above and coated with pale tomentum below, and at maturity are thick and firm, glabrous, conspicuously reticulate-venulose, bright green on the upper surface and glaucous or silvery white on the lower, from three to five inches long and from three quarters of an inch to an inch and a half wide, with broad yellow midribs, slender arcuate primary veins, slightly thickened and revolute margins, and slender petioles from one half of an inch to an inch in length. The stipules are foliaceous, semilunate, acute, glandular-dentate, about a quarter of an inch in length, and deciduous. The aments are erect and terminal on abbreviated branches with leaves reduced to oblong acute deciduous scales and coated with thick white tomentum, and appear late in winter or in very early spring before the foliage; they are oblong-cylindrical, about an inch long and two thirds of an inch thick, and those of the staminate plant, which are soft and silky before the flowers open, are densely flowered and often incurved above the middle; their scales are oblong-obovate, dark reddish brown above the middle, and clothed on the back with long silky silvery white hairs. The stamens are two in number, with elongated glabrous filaments. The ovary is oblong-cylindrical, attenuated above the middle, villous, long-stalked, and crowned by a short distinct style and broad spreading entire stigmas. The capsule is cylindrical, more or less contracted above the middle, long-pointed, light brown, and coated with pale pubescence.

A form of this species in which the lower surface of the leaves is clothed with ferrugineous pubes-

cence and the aments are more thickly covered with silvery lustrous hairs, is var. *eriocephala*;[1] and a form with narrower leaves, more loosely flowered and less hairy aments, long styles, laciniately divided stigmas, and less pubescent capsules, is var. *prinoides*.[2]

Salix discolor is a common inhabitant of moist meadows and the banks of streams and lakes, and is distributed from Nova Scotia to Manitoba,[3] and southward in the United States to Delaware, southern Indiana and Illinois and northeastern Missouri.

The wood of *Salix discolor* is light, soft, and close-grained; it is brown streaked with orange, with lighter brown sapwood, and contains conspicuous medullary rays and bands of open ducts marking the layers of annual growth. The specific gravity of the absolutely dry wood is 0.4261, a cubic foot weighing 26.55 pounds.

[1] *Salix discolor*, subspec. *eriocephala*, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 85 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 225. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 169. — Macoun, *Cat. Can. Pl.* 447. — Bebb, *Brewer & Watson Gray's Man.* ed. 6, 482.

Salix eriocephala, Michaux, *Fl. Bor.-Am.* ii. 225 (1803). — Bigelow, *Fl. Boston.* 239. — Emerson, *Trees Mass.* 259; ed. 2, i. 296, t. — Carey, *Gray's Man.* 426. — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 117 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 57. — Walpers, *Ann.* v. 746.

Salix crassa, Barratt, *Sal. Amer.* No. 7 (1840).

Salix discolor, subspec. *eriocephala*, var. *parviflora*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* 85 (1867).

Salix discolor, subspec. *eriocephala*, var. *rufescens*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* (1867).

[2] *Salix discolor*, subspec. *prinoides*, Andersson, *l. c.* 86 (1867); *De Candolle, l. c.* — Emerson, *l. c.* ed. 2, 297. — Sargent, *l. c.* — Bebb, *l. c.*

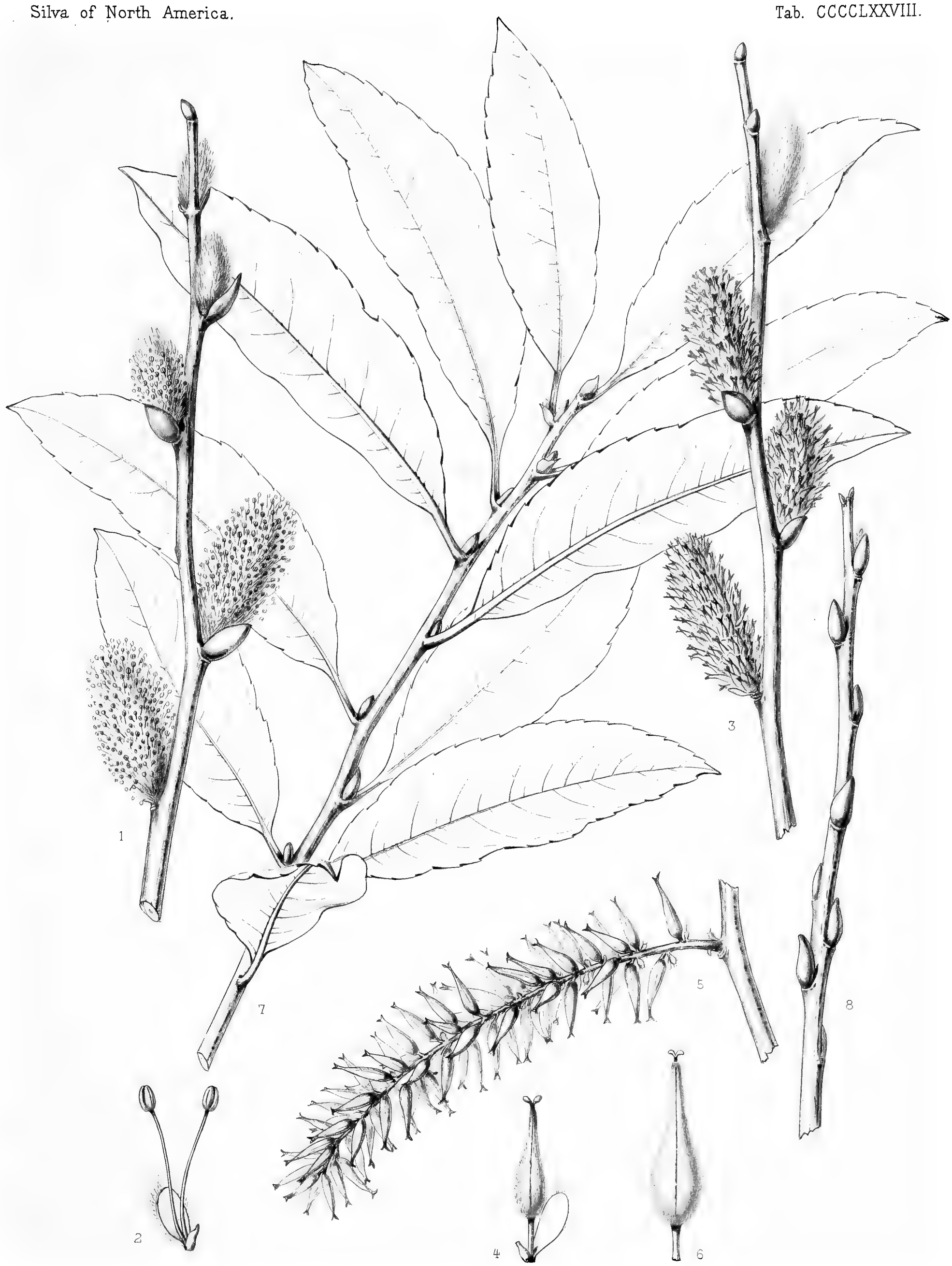
Salix prinoides, Pursh, *Fl. Am. Sept.* ii. 613 (1814). — Nuttall, *Gen.* ii. 231. — Poiret, *Lam. Dict.* Suppl. v. 67. — Sprengel, *Syst.* i. 102. — Forbes, *Salict. Woburn.* 79, t. — Koch, *Sal. Europ. Comm.* 46. — Loudon, *Arb. Brit.* iii. 1530, f. 1317, 1612, f. 40. — Hooker, *Fl. Bor.-Am.* ii. 150. — Emerson, *Trees Mass.* 259. — Dietrich, *Syn.* v. 419.

[3] Provancher, *Fl. Canadienne*, ii. 527. — Macoun, *Cat. Can. Pl.* 447.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXVIII. SALIX DISCOLOR.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting ament, natural size.
6. A capsule, enlarged.
7. A summer branch, natural size.
8. A winter branch, natural size.



C.E. Faxon del.

Himely sc.

SALIX DISCOLOR, Muehl.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

SALIX CORDATA, var. MACKENZIEANA.

Willow.

LEAVES lanceolate or oblanceolate, acuminate, dark green on the upper surface, pale on the lower.

Salix cordata, γ **Mackenzieana**, Hooker, *Fl. Bor.-Am.* ii. 149 (1839). — Bebb, *Brewer & Watson Bot. Cal.* ii. 86; *Coulter Man. Rocky Mt. Bot.* 335; *Garden and Forest*, viii. 473.

Salix cordata × **vagans**, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 125 (*Bidr. Nordam. Pilarter*) (1858).

Salix cordata × **rostrata**, Andersson, *Proc. Am. Acad.* iv. 65 (1858); *De Candolle Prodr.* xvi. pt. ii. 252.

Salix cordata, subspec. **Mackenzieana**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 160 (*Monographia Salicum*) (1867).

A small tree, with a slender trunk, and upright branches forming a narrow shapely head. The bark of the trunk is smooth, pale and yellowish or gray in color. The branchlets are slender, marked with scattered lenticels, glabrous or slightly puberulous at first and often deeply tinged with red, but soon become yellow and lustrous and grow lighter colored in their second year, when they are more or less tinged with green. The buds are ovate, rounded on the back, compressed and acute at the apex, flattened by pressure against the stem, bright orange-color, and about an eighth of an inch in length. The leaves are involute in the bud, lanceolate or oblanceolate, gradually narrowed or wedge-shaped or rounded at the base, long-pointed and occasionally slightly falcate above the middle, and finely and obscurely crenately serrate, or entire; when they unfold they are reddish and pilose with caducous pale hairs, and at maturity are thin and firm in texture, dark green above, pale below, from two to three inches long and about half an inch wide, with slender yellow midribs and arcuate veins, obscure reticulate veinlets, and thin yellow petioles about a third of an inch in length. The stipules are reniform, conspicuously venulose, about a sixteenth of an inch broad, and usually persistent during the season. The aments are oblong-cylindrical, densely flowered, erect, often more or less curved, about an inch and a half long, and terminal on short branchlets with leaves sometimes reduced to scales on the staminate plant; the rachis of the staminate ament is covered by a coat of thick white tomentum, and that of the pistillate ament is tomentose; their scales are oblong-obovate, acute, dark-colored, glabrous except at the base, and persistent under the fruit. The stamens are two in number, with elongated free glabrous filaments. The ovary is cylindrical, elongated, gradually narrowed into a slender style crowned by spreading emarginate stigmas, and raised on a slender stalk three or four times as long as the scale. The capsule is elongated, long-stalked, light brown slightly tinged with red, and about a quarter of an inch in length.

Salix cordata, var. *Mackenzieana*, which is still very little known, is distributed from the shores of Great Slave Lake southward through the region at the eastern base of the Rocky Mountains to northern Idaho and to Lake County, California, and is now usually regarded as a western form of the shrubby *Salix cordata*,[1] one of the commonest and most variable Willows of North America, ranging

[1] Muehlenberg, *Neue Schrift. Gesell. Nat. Fr. Berlin*, iv. 236, t. 6, f. 3 (1803); *Konig & Sims Ann. Bot.* ii. 64, t. 5, f. 3. — Michaux, *Fl. Bor.-Am.* ii. 225. — Willdenow, *Spec.* iv. pt. ii. 666. — Persoon, *Syn.* ii. 599. — Pursh, *Fl. Am. Sept.* ii. 615. — Nuttall, *Gen.* ii. 231. — Forbes, *Salict. Woburn.* 277. — Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 623. — Hooker, *Fl. Bor.-Am.* ii. 149. — Barratt, *Sal. Amer.* No. 26. — Torrey, *Fl. N. Y.* ii. 211. — Emerson, *Trees Mass.* 275; ed. 2, i. 299, t. — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 124 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 64; *Svensk. Vetensk. Akad. Handl.* ser. 4, v. 157 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 251. — Ward, *Bull. U. S. Nat. Mus.* No. 22, 116 (*Fl. Washington*). — Bebb,

from the Arctic Circle to the northern United States, and from the shores of the Atlantic Ocean to British Columbia and California.

The wood of *Salix cordata*, var. *Mackenzieana*, has not been examined.

Brewer & Watson Bot. Cal. ii. 85; *Coulter Man. Rocky Mt. Bot.* 335; *Watson & Coulter Gray's Man.* ed. 6, 484. — Dudley, *Bull. Cornell University*, ii. 90 (*Cayuga Fl.*).

Salix rigida, Muehlenberg, *Neue Schrift. Gesell. Nat. Fr. Berlin*, iv. 237, t. 6, f. 4 (1803); *Konig & Sims Ann. Bot.* ii. 64, t. 5, f. 4. — Willdenow, *Spec.* iv. pt. ii. 667. — Pursh, *Fl. Am. Sept.* ii. 615. — Forbes, *Salict. Woburn.* 277. — Hooker, *Fl. Bor.-Am.* ii. 149. — Trautvetter, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, iii. 624. — Barratt, *Sal. Amer.* No. 27. — Torrey, *Fl. N. Y.* ii. 212. — Emerson, *Trees Mass.* 276.

Salix angustata, Pursh, *l. c.* 613 (1814). — Carey, *Gray's Man.* 427.

Salix Torreyana, Barratt, *l. c.* No. 29 (1840). — Emerson, *l. c.* 277.

Salix cordata, var. *rigida*, Carey, *l. c.* (1848).

Salix cordata, subspec. *rigida*, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 158 (*Monographia Salicum*) (excl. vars. a *myricoides*, d *vestita*) (1867).

Salix cordata, subspec. *rigida*, a *latifolia*, Andersson, *l. c.* (1867).

Salix cordata, subspec. *rigida*, b *angustifolia*, Andersson, *l. c.* 159 (1867).

Salix cordata, subspec. *angustata*, Andersson, *l. c.* (1867).

Salix cordata, subspec. *angustata discolor*, Andersson, *l. c.* (1867).

Salix cordata, subspec. *angustata viridula*, Andersson, *l. c.* (1867).

Salix cordata, subspec. *angustata vitellina*, Andersson, *l. c.* (1867).

Salix angustata crassa, Andersson, *l. c.* (1867).

Salix myricoides, K. Koch, *Dendr.* ii. pt. i. 579 (in part) (not Muehlenberg) (1872). — Koehne, *Deutsche Dendr.* 98.

Salix myricoides, a *cordata*, Dippel, *Handb. Laubholzk.* ii. 83, f. 134 (1892).

Salix myricoides, b *rigida*, Dippel, *l. c.* (1892).

Salix myricoides, c *angustata*, Dippel, *l. c.* (1892).

A form of *Salix cordata*, the so-called Diamond Willow (*Salix cordata*, var. *vestita*, in part at least of many authors but not of Andersson), frequently confounded with *Salix Missouriensis*, is remarkable for the arrest of wood growth at the atrophied branchlets, causing the presence of large diamond-shaped depressions on the stems; it is a tall shrub of the middle Missouri River basin, where in South Dakota it is the most characteristic woody plant, its peculiar clumps of numerous stems sometimes thirty feet tall forming one of the prominent features of the vegetation along the borders of streams. In eastern Nebraska, where it is less abundant, it is called Red Willow. The reddish wood is said to be durable and used for stakes and fence-posts. (See Williams, *Garden and Forest*, viii. 493.)

A small and little known arborescent Willow of this group (*Salix lutea*, Nuttall, *Sylva*, i. 63, t. 19 (1842). *Salix cordata*, var. *lutea*, Bebb, *Garden and Forest*, viii. 473 [1895]), of southern Assiniboia and northern Montana, is not included in this volume, as it has been impossible to obtain sufficient material from which to make the plate, which, it is hoped, will appear later.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXIX. SALIX CORDATA, VAR. MACKENZIEANA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A fruiting branch, natural size.
5. A capsule, enlarged.

C. E. Faxon del. *Rapine sc.*

SALIX CORDATA var. MACKENZIEANA, Hook.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

SALIX MISSOURIENSIS.

Willow.

LEAVES lanceolate or oblanceolate, long-pointed, pale and often silvery white below.

Salix Missouriensis, Bebb, *Garden and Forest*, viii. 373 (1895).

Salix cordata, subspec. **rigida**, d **vestita**, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 159 (*Monographia Salicum*) (not *Salix vestita*, Pursh) (1867); *De Candolle Prodr.* xvi. pt. ii. 252.

Salix cordata, var. **vestita**, Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 170 (1884).

A tree, often forty or fifty feet in height, with a tall straight trunk ten or twelve or rarely eighteen inches in diameter, and rather slender upright slightly spreading branches which form a narrow open symmetrical head. The bark of the trunk is thin, smooth, light gray slightly tinged with red, and covered with minute closely appressed plate-like scales. The branchlets are slender and marked with small scattered orange-colored lenticels, and when they first appear are light green and coated with thick pale pubescence; this continues to cover them during their first year, when they are reddish brown, and in their second winter they are brown tinged with green and glabrous or puberulous. The buds are ovate, rounded on the back, flattened or acute at the apex, closely pressed against the stem, bright reddish brown, clothed with a thick coat of hoary tomentum, and nearly an inch long. The leaves are involute in the bud, lanceolate or oblanceolate, gradually narrowed from above the middle to the wedge-shaped or rounded base, acuminate and long-pointed at the apex, and finely serrate with minute incurved glandular teeth; in the bud they are furnished with a fringe of long silky lustrous caducous white hairs, and when they unfold are coated with pale hairs on the lower surface and are pilose on the upper; they soon become smooth, with the exception of the upper side of the stout yellow midribs, which are often puberulous during the season, and at maturity they are thin and firm in texture, dark green above, pale and often glaucous below, from four to six inches long and from an inch to an inch and a half wide, with slender veins forked and united within the margins and connected by reticulate cross veinlets, and stout pubescent or tomentose petioles from one half to three quarters of an inch long; those of the first pair are ovate, acute, clothed with long silky white hairs, about an eighth of an inch long when full grown, and united at the base to the membranaceous light green glabrous stipular separable inner coat of the bud-scale. The stipules are foliaceous, semicordate and pointed, or rarely reniform and obtuse, serrate with incurved teeth, dark green and glabrous on the upper side, coated on the lower with hoary tomentum, reticulate-venulose, often half an inch long, and deciduous or persistent during the season. The aments are oblong-cylindrical, erect and densely flowered, and appear before the foliage early in February on short leafy branches; the staminate is an inch and a half in length and nearly half an inch in width and rather longer than the more slender ament of the pistillate plant, which at maturity is somewhat lax and from three to four inches long; their scales are oblong-obovate, light green, and clothed on the outer surface with long straight silvery hairs. The stamens are two in number, with elongated free glabrous filaments. The ovary is short-stalked, cylindrical, rostrate from a thick base, glabrous, and crowned by a short style and spreading entire or slightly emarginate stigmas. The capsule is narrow, long-pointed, light reddish brown, and raised on a slender stalk about the length of the persistent scale.

Salix Missouriensis grows on the deep sandy alluvial bottom-lands of the Missouri River in the extreme western part of Missouri,[1] where it is associated with the Red Maple, the Green Ash, the

[1] *Salix Missouriensis* has been collected by Mr. B. F. Bush at Courtney in Jackson County, twenty miles from its original station at Fort Osage, where it is abundant on the Missouri River bottoms, and near Watson, Atchison County.

Liquidambar, the Black Willow, the Sand-bar Willow, and the Cottonwood, and in the neighborhood of St. Louis.[1]

The wood of *Salix Missouriensis* is dark reddish brown, with thin pale sapwood, and is said to be very durable in contact with the ground and to be used for fence-posts; it has not been critically examined.

Salix Missouriensis was first collected at Fort Osage on the Missouri River by the German naturalist, Maximilian, Prinz von Neuwied,[2] and was first described by Nils Johan Andersson,[3] the Swedish salicologist.

[1] In the neighborhood of St. Louis *Salix Missouriensis* has been collected at several places by Dr. N. M. Glatfelter during the summer of 1895.

[2] Maximilian Alexander Philipp, Prinz von Neuwied (1782–1867), was born at Neuwied and entered the German army, from which he retired in 1815 with the rank of major-general to devote himself to the study of science. From 1815 to 1817 he traveled in the interior of Brazil with the naturalists Neirciss and Sellow, the scientific results of this journey appearing in a number of memoirs. In 1832 Maximilian visited the United States, landing in Boston on the 4th of July. He remained for nearly three years in this country and penetrated to the then little known region watered by the upper Missouri River with the intention of crossing the Rocky Mountains. Failing in this, he retraced his steps and returned to Europe, where, assisted by a number of specialists, he published an account of his journey. His collections made in North and South America are preserved in the museum of his native city. *Maximiliana*, a genus of Brazilian and West Indian Palms, was dedicated to him by Martius.

[3] Nils Johan Andersson (February 21, 1821–March 27, 1880) was born in Linköping, and in 1845 graduated as Doctor of Philosophy at the University of Upsala, where he resided for several years as assistant professor of botany. As naturalist he took part in the voyage of the Swedish frigate Eugenie in the years 1851–53, and in 1852 made collections of plants in California. In 1855 he became demonstrator of botany at the University at Lund, and in the following year was appointed professor of botany, director of the Botanic Garden, and superintendent of the botanical division of the Royal Museum. An author of numerous botanical memoirs, text-books, and books of travel, Andersson is best known by his studies of Salix, upon which he wrote many papers and the classical monograph of the genus published in the sixteenth volume of the *Prodromus* of De Candolle.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXX. SALIX MISSOURIENSIS.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A raceme of fruit, natural size.
6. A capsule, enlarged.
7. A summer branch, natural size.
8. A winter branch, natural size.

C E Faxon del

Rapine sc

SALIX MISSOURIENSIS, Bebb

A Riocreux direx.t

Imp J Taneur, Paris

SALIX LASIOLEPIS.

White Willow.

LEAVES oblanceolate or lanceolate-oblong, dark green on the upper surface and pale and glaucous and pubescent or puberulous on the lower.

Salix lasiolepis, Bentham, *Pl. Hartweg.* 335 (1857). — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 118 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 58; *De Candolle Prodr.* xvi. pt. ii. 264. — Walpers, *Ann.* v. 747. — Bebb, *Brewer & Watson Bot. Cal.* ii. 86; *Bot. Gazette*, xvi. 104. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 170. — Coville, *Contrib. U. S. Nat. Herb.* iv. 199 (*Bot. Death Valley Exped.*). — Greene, *Man. Bot. Bay Region*, 300.

Salix Bigelovii, Torrey, *Pacific R. R. Rep.* iv. pt. v. 139 (1856?). — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 118 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 58; *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 163 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 255. — Walpers, *Ann.* v. 747. — Greene, *Man. Bot. Bay Region*, 299.

Salix Bigelovii, a latifolia, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 163 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 255.

Salix Bigelovii, b angustifolia, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 163 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 255.

Salix Bigelovii, var. fuscior, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 163, f. 94 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 255.

Salix —— ?, Watson, *King's Rep.* v. 325 (1871).

Salix lasiolepis, var. Bigelovii, Bebb, *Brewer & Watson Bot. Cal.* ii. 86 (1880).

Salix lasiolepis, var. (?) **fallax, Bebb**, *Brewer & Watson Bot. Cal.* ii. 86 (1880).

A tree, from twenty to thirty or occasionally fifty feet in height, with a trunk from twelve to eighteen inches in diameter, and slender erect branches which form a loose open head; or often, at the north and at high elevations, reduced to a low shrub. The bark of old trunks is dark, about a third of an inch thick, roughened by small lenticels and broken into broad flat irregularly connected ridges; on young stems and on the branches it is much thinner, smooth, and light gray-brown. The branchlets are stout, coated at first with hoary tomentum, and during their first year bright yellow or dark reddish brown and puberulous or pubescent, becoming darker and glabrous in their second season. The buds spread slightly from the stem and are ovate, acute, compressed, rounded anteriorly and posteriorly, contracted laterally into thin wing-like margins, light brownish yellow, and glabrous or puberulous. The leaves are involute in the bud, oblanceolate or lanceolate-oblong, often inequilateral and occasionally falcate, gradually narrowed and wedge-shaped or abruptly contracted and wedge-shaped and cuneate or rounded at the base, acute or acuminate and apiculate or rarely rounded at the apex, and entire or remotely serrate with minute spreading callous teeth; when they unfold they are pilose above and coated below with thick hoary tomentum, and at maturity are thick and subcoriaceous, conspicuously reticulate-venulose, dark green and glabrous on the upper surface, pale or glaucous and pubescent or puberulous on the lower, from three to six inches long and from half an inch to an inch wide, with broad yellow midribs and slender arcuate veins forked and united within the slightly thickened and revolute margins; they are borne on slender petioles which vary from one eighth to one half of an inch in length, and at the south often remain on the branches until the appearance of the flowers in winter or early spring. The stipules are ovate, acute, coated with hoary tomentum, minute and caducous, or sometimes foliaceous, semilunar, acute or acuminate, entire or denticulate, dark green on the upper surface, pale on the lower, and persistent. The aments, which appear from December at the south to March at the north, are erect, cylindrical, slightly flexuous, densely flowered, and nearly sessile on abbreviated tomentose branchlets which bear two or three small leaves or caducous hairy scales;

they are about an inch and a half long, and those of the staminate plant are half an inch thick and nearly twice as thick as those of the pistillate plant, which, when the fruit ripens, are sometimes nearly three inches long; the scales are oblong-obovate, rounded or acute at the apex, dark colored, clothed with long crisp white hairs, and persistent under the fruit. The stamens are two in number, with elongated glabrous filaments more or less united below the middle. The ovary is narrow, cylindrical, acute and long-pointed, dark green, glabrous, and crowned by the short style and broad nearly sessile stigmas. The capsule is oblong, cylindrical, light reddish brown, about a quarter of an inch in length, and at the south ripens in March.

Salix lasiolepis inhabits the banks of streams and low moist ground, and is distributed from the valley of the Klamath River southward through western California to Lower California,[1] and to the mountains of southern Arizona.[2] It is the commonest and one of the most variable[3] of the California Willows, growing at the south and at low altitudes as a small or large tree, but in the north and on the western slopes of the Sierra Nevadas, which it ascends to elevations of three or four thousand feet above the sea, reduced to a low many-stemmed shrub.[4]

The wood of *Salix lasiolepis* is light, soft, close-grained, but not strong; it contains numerous thin medullary rays, and is light brown, with thick nearly white sapwood. The specific gravity of the absolutely dry wood is 0.5587, a cubic foot weighing 34.82 pounds. In southern California it is often used as fuel.

Salix lasiolepis was discovered near Monterey, California, by the German collector Hartweg[5] in 1846, and near San Francisco in 1854[6] by Dr. J. M. Bigelow.[7]

[1] Brandegee, *Proc. Cal. Acad.* ser. 2, ii. 205 (*Pl. Baja Cal.*).

[2] A shrubby form of *Salix lasiolepis*, with numerous stems eight or ten feet high, oblanceolate leaves gradually narrowed and wedge-shaped at the base, acute and occasionally rounded at the apex, mostly remotely and finely crenately serrate, especially above the middle, and pale silvery white and puberulous on the lower surface, was found in 1894 by Dr. T. S. Wilcox of the United States army in Tanner's Cañon on the Huachuca Mountains in southern Arizona. It was also found by Professor J. W. Toumey in White River Cañon of the Chericahua Mountains in July, 1894.

[3] In one of the ordinary forms of this species the leaves are oblanceolate or occasionally oblong-oblanceolate, acute or acuminate, more or less pubescent below, irregularly and unequally serrate, and subcoriaceous, those at the base of the aments being reduced to minute scales. In another form (var. *Bigelovii*, Bebb) the leaves are thinner, obovate or cuneate-obovate, often obtuse or rounded at the apex, and hoary-pubescent below, and the aments are raised on short leafy branchlets; and in another (var. *fallax*, Bebb) the leaves are lanceolate-oblong, abruptly contracted and sometimes rounded at the base, and glaucous and pale below; the stipules are larger, semilunar, and persistent, and the smaller aments are rather less densely flowered.

[4] *Salix lasiolepis* is reported to be common on the banks of streams in the valley of Hatwai Creek, Nez Perces County, western Idaho (Holzinger, *Contrib. U. S. Nat. Herb.* iii. 251).

[5] See ii. 34.

[6] Bigelow's specimens are the types of Torrey's *Salix Bigelovii*, published in the fourth volume of the Pacific Railroad Reports. The date on the title-page of this volume is 1856, but the introduction, signed by Torrey, is dated January 12, 1857, and in his description of other Willows in this Report reference is made to the fasciculus of the *Plantæ Hartwegianæ* of Bentham which was published in London in 1857, and in which *Salix lasiolepis* was first described. Whatever may have been the real date of publication of the fourth volume of the Pacific Railroad Reports, it is evident that the portion of it in which the Willows are described did not appear until after the publication of the last fasciculus of the *Plantæ Hartwegianæ*, and that Bentham's name for this Willow is the older.

[7] See i. 88.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXXI. SALIX LASIOLEPIS.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A summer branch, natural size.
8. A winter branch, natural size.

C.E. Faxon del. Himely sc.

SALIX LASIOLEPIS, Benth.

A. Riocreux dirext. Imp. J. Taneur, Paris.

SALIX NUTTALLII.

Black Willow.

LEAVES oblong-obovate, acute, acuminate or rounded at the apex, bright yellow-green on the upper surface.

Salix Nuttallii, Sargent, *Garden and Forest*, viii. 463 (1895).

Salix flavescens, Nuttall, *Sylva*, i. 65 (not Host) (1842). — Bebb, *Brewer & Watson, Bot. Cal.* ii. 86 (in part); *Bot. Gazette*, vii. 129; xvi. 105; *Coulter Man. Rocky Mt. Bot.* 336. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 169. — Coville, *Contrib. U. S. Nat. Herb.* iv. 198 (*Bot. Death Valley Exped.*). — F. Kurtz, *Bot. Jahrb.* xix. 406 (*Fl. Chilcatgebietes*).

A tree, occasionally thirty feet in height, with a short trunk rarely exceeding a foot in diameter, and slender pendulous branches which form a rather compact round-topped shapely head. The bark is thin, dark brown slightly tinged with red, and divided into broad flat ridges. The branchlets are stout and marked with scattered yellow lenticels, and at first are coated with pale pubescence which soon disappears or often continues to cover them until midsummer; during their first season they vary in color from bright yellow to dark orange-color, and in their second year are dark red-brown and roughened by the conspicuous elevated leaf-scars. The buds are ovate, acute, nearly terete or slightly flattened, with narrow lateral wing-like margins, and are light or dark orange-color, glabrous or pilose at the base, and about a quarter of an inch in length. The leaves are involute in the bud, oblong-obovate, gradually narrowed and wedge-shaped at the base, which is often unequal, acute or abruptly acuminate with short or long points or broad and rounded at the apex, and entire or remotely and irregularly crenately serrate; when they unfold they are pilose above and coated below with pale pubescence or tomentum, and at maturity are thin and firm in texture, dark yellow-green and lustrous on the upper surface, pale and glabrous or pilose on the lower, from an inch and a half to four inches long and from half an inch to an inch and a half wide, with broad yellow pubescent midribs, slender veins forked and arcuate within the slightly thickened and revolute margins and connected by conspicuous reticulate veinlets, and slender puberulous petioles from one quarter to one half of an inch in length; the lowest leaves are ovate, acute, and coated with thick hoary tomentum, and fall when less than an inch in length. The stipules are foliaceous, semilunar, glandular-serrate, from an eighth to a quarter of an inch long, and caducous. The aments, which appear before the unfolding of the leaves, are oblong-cylindrical, erect, and nearly sessile on short tomentose branches furnished with two or three small scale-like caducous or persistent leaves coated with long white hairs; those of the staminate plant are about an inch long and rather more than half an inch thick, and those of the pistillate plant are an inch and a half long, about three eighths of an inch thick, and rather lax, becoming from two to three inches in length when the capsules mature; the scales are oblong, narrowed at both ends and acute at the apex, dark-colored, coated with long white hairs, and persistent under the fruit. The stamens are two in number, with free glabrous filaments. The ovary is cylindrical, long-pointed, coated with hoary pubescence, crowned with the nearly sessile broad emarginate stigmas, and raised on a short stalk about one third as long as the scale. The capsule is light reddish brown, coated with pale pubescence, and about a third of an inch in length.

Salix Nuttallii inhabits the borders of mountain streams usually only at high elevations, and is distributed from southern Assiniboia and the banks of the Columbia River, near Donald in British

Columbia,[1] southward through the Rocky Mountain region to northern New Mexico and Arizona,[2] and along the California Sierra Nevada to the San Bernardino Mountains, upon which it grows as a low shrub at elevations of from seven to ten thousand feet above the level of the sea.[3]

The wood of *Salix Nuttallii* is light, soft, and close-grained, but not strong; it is light brown tinged with red, with thick nearly white sapwood, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4969, a cubic foot weighing 30.97 pounds.

In the Pacific coast region *Salix Nuttallii* is represented by the variety *brachystachys*,[4] which is distributed from Alaska to the vicinity of Santa Barbara, California, and is sometimes a tree sixty or seventy feet in height, with a tall trunk often two feet and a half in diameter, or frequently a shrub with stems not more than two or three feet in height. The bark is about a quarter of an inch in thickness, light gray, slightly fissured, and irregularly divided into thin plate-like scales which in falling disclose the dark red inner bark. The branchlets are stout, light yellow and pubescent at first, and in their second season dark reddish brown and usually glabrous. The buds are coated with pale pubescence, and are about a quarter of an inch in length. The leaves are obovate, rounded or acute at the apex, about an inch and a half long and nearly an inch wide, or on large trees often three or four inches long and an inch and a half wide; on vigorous shoots they are sometimes oblong-obovate, coarsely crenately serrate, hoary-pubescent below, from four to six inches in length and from an inch and a half to two inches in breadth, with large foliaceous semilunar dentate stipules silvery white and pubescent on the lower surface. The pistillate aments are rather shorter than those of the mountain tree and often curved.

Salix Nuttallii, var. *brachystachys*, is the most abundant Willow in western Washington and Oregon, attaining its greatest size in swamps and on the bottom-lands of rivers near the shores of Puget Sound; it is less common in the California coast region, where it usually grows on hillsides near springs, and is rarely more than twenty feet in height, with a contorted stem and bushy head, and sometimes in the neighborhood of Monterey in dry sandy soil under the shade of Pine-trees as a shrub only a few feet high.

The wood of *Salix Nuttallii*, var. *brachystachys*, is light, hard, strong, tough, and close-grained; it is light red-brown, with thick brown sapwood, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.5412, a cubic foot weighing 33.73 pounds.

[1] Macoun, *Cat. Can. Pl.* 448.

[2] In September, 1894, *Salix Nuttallii* was found by J. W. Toumey and C. S. Sargent on the northern slopes of the San Francisco Mountain, at an elevation of 8,000 feet above the sea, growing as a large shrub.

[3] S. B. Parish, *Zoë*, iv. 347.

[4] *Salix Nuttallii*, var. *brachystachys*.

Salix brachystachys, Bentham, *Pl. Hartweg.* 336 (1857). — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 121 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 60; *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 82, t. 5, f. 48 (*Monographia Salicum*); *De Candolle Prodr.* xvi. pt. ii. 224.

Salix Scouleriana, Hooker, *Fl. Bor.-Am.* ii. 145 (in part) (1839). — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 29.

Salix capreoides, Andersson, *Öfvers Vetensk. Akad. Förhandl. l. c.* 120 (1858); *Proc. Am. Acad. l. c.*

Salix brachystachys, subspec. *Scouleriana*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* 83 (1867); *De Candolle Prodr. l. c.* 224.

Salix brachystachys, subspec. *Scouleriana tenuijulis*, Andersson, *Svensk. Vetensk. Akad. Handl. l. c.* (1867); *De Candolle Prodr. l. c.* 225.

Salix brachystachys, β *Scouleriana crassijulis*, Andersson, *De Candolle Prodr. l. c.* (1868).

Salix flavescens, Bebb, *Brewer & Watson Bot. Cal.* ii. 86 (in part) (1880). — Coville, *Contrib. U. S. Nat. Herb.* iv. 198 (*Bot. Death Valley Exped.*).

Salix flavescens, var. *Scouleriana*, Bebb, *Bot. Gazette*, vii. 129 (1882). — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 170. — Macoun, *l. c.* — Holzinger, *Contrib. U. S. Nat. Herb.* iii. 251.

Salix flavescens, var. *capreoides*, Bebb, *Garden and Forest*, viii. 373 (1895).

Salix Nuttallii, var. *capreoides*, Sargent, *Garden and Forest*, viii. 463 (1895).

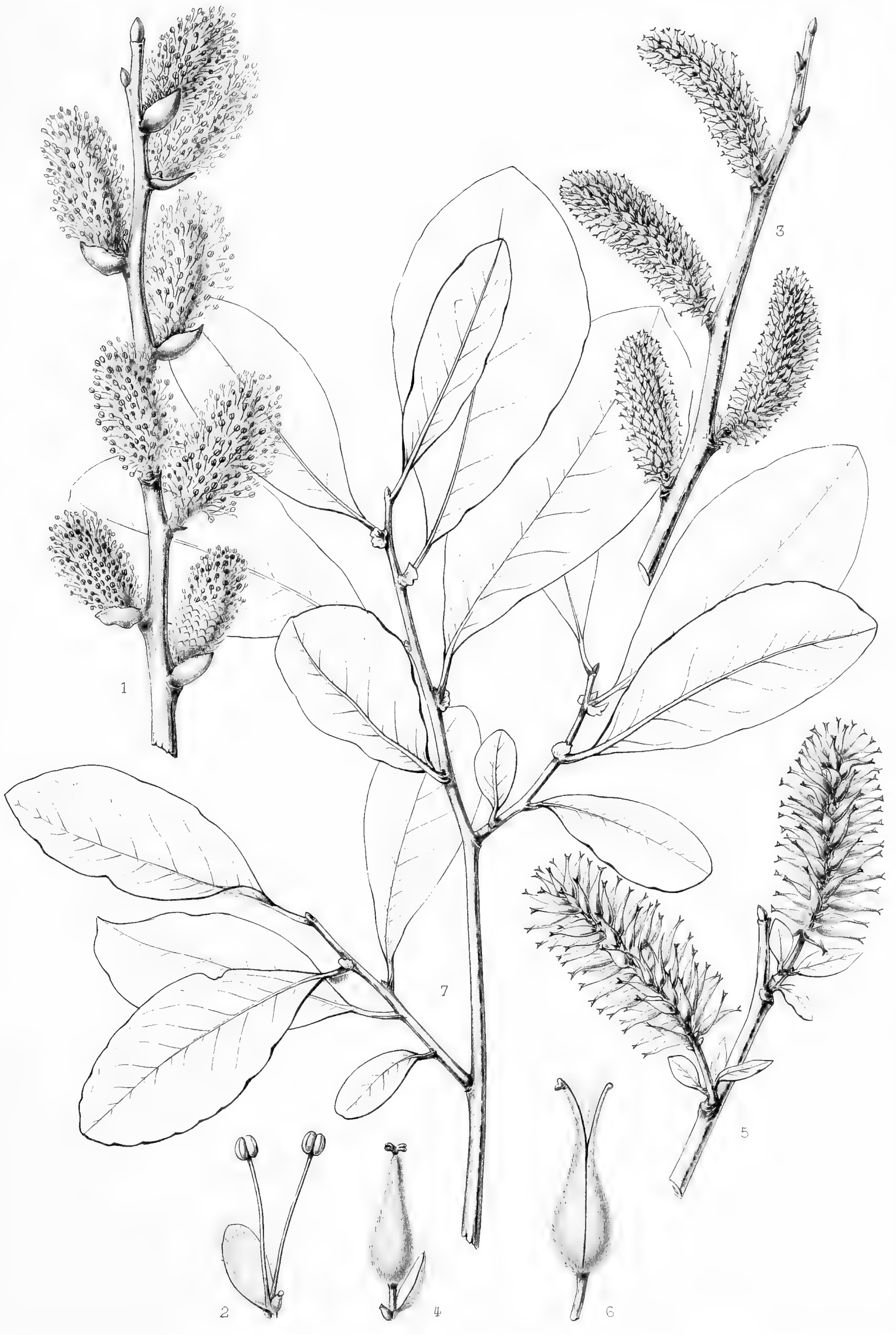
EXPLANATION OF THE PLATES.

Plate CCCCLXXXII. Salix Nuttallii.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A summer branch, natural size.

Plate CCCCLXXXIII. Salix Nuttallii, var. brachystachys.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting ament, natural size.
6. A capsule, enlarged.
7. A summer branch, natural size.
8. A summer branch, natural size.



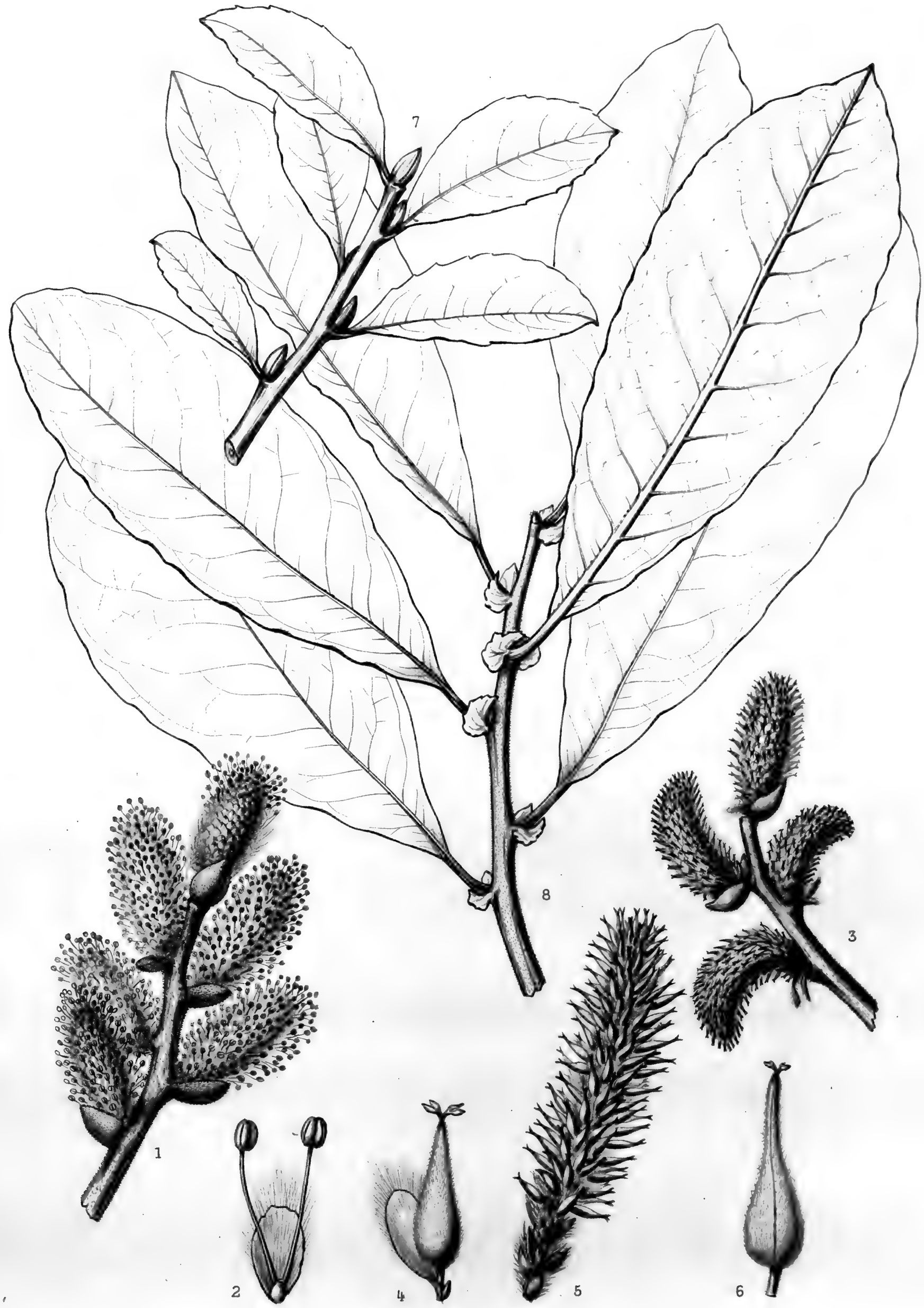
C.E. Faxon del.

Himely sc.

SALIX NUTTALLII, Sarg.

A. Riocreux direx.t

Imp. J. Taneur, Paris.



C.E. Faxon del.

Himely sc.

SALIX NUTTALLII, var. BRACHYSTACHYS, Sarg.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

SALIX PIPERI.

Willow.

LEAVES elliptical-oblong, obovate, or oblanceolate, dark green on the upper surface, glaucous on the lower.

Salix Piperi, Bebb, *Garden and Forest*, viii. 482 (1895).

A shrub, with several stems rising from the ground to the height of eighteen or twenty feet, usually free of branches except near the top, four or five inches in diameter, and covered with smooth light brown bark. The branchlets are stout, glabrous, dark red-brown, very lustrous, and marked with scattered light orange-colored lenticels. The buds spread slightly from the stem above the middle, and are ovate, rounded at the flattened and somewhat incurved apex, full and rounded on the anterior side and flattened or slightly rounded on the posterior, compressed along the margins into narrow wings, dark or light chestnut-brown, lustrous, and often a third of an inch in length. The leaves are conduplicate in the bud, elliptical-oblong, obovate, or oblanceolate, gradually narrowed and rounded or wedge-shaped at the base, acuminate with short broad and often oblique points or acute or rarely rounded at the apex, which is tipped with a minute gland, and coarsely crenate with small spreading glandular teeth, or entire with slightly undulate margins; when they unfold they are pilose above and coated below with pale caducous pubescence, and at maturity they are thin and firm in texture, glabrous, dark green and lustrous on the upper surface and silvery white on the lower, from four to seven inches long and from an inch and a half to two inches wide, with stout dark orange-colored midribs, prominent primary veins arcuate and united near the margins and connected by conspicuous reticulate veinlets, and slender slightly grooved glabrous or puberulous petioles from one half to three quarters of an inch in length; the leaves of the first pair are oblong-obovate, rounded above, gradually narrowed below, and coated with thick pale or rusty tomentum, and fall when less than an inch long. The stipules are foliaceous, reniform, silvery white on the lower surface, at least a quarter of an inch in length, and caducous, or often wanting. The aments are terminal and oblong-cylindrical, and appear with or just before the foliage; those of the staminate plant are nearly sessile, furnished at the base with two or three scale-like bracts coated with long silky white hairs, from an inch to an inch and a half long, two thirds of an inch thick, silvery white before the appearance of the stamens, and nearly twice as thick as those of the pistillate plant, which are raised on short branches covered, like the under surface of their small leaves, with hoary tomentum; the scales are oblong-obovate, rounded at the apex or nearly orbicular, dark-colored, and coated with long straight slender lustrous hairs which are longer and more brilliant on those of the staminate ament. The stamens are two in number, with slender glabrous filaments free or often united nearly to the middle. The ovary is oblong-lanceolate, rather abruptly narrowed above the middle, glabrous, raised on a slender stalk nearly as long as the scale, and surmounted by an elongated slender orange-colored style and erect entire stigmas.

Salix Piperi has been distinguished only in western Washington, where it was discovered in April, 1889, by Professor C. V. Piper.[1]

[1] Charles Vancouver Piper was born in Victoria, British Columbia, on June 16, 1867, and in 1874 moved to Seattle, Washington, where he was educated in the grammar and high schools, and in the State University of Washington, from which he was graduated in 1881. Botany and entomology had been his favorite studies from childhood, and before and after he left college Mr. Piper had explored nearly all parts of the state of Washington and made large collections of plants and insects. In 1892 he was appointed to the chair of botany and zoölogy in the Washington Agricultural College and School of Science, and was made botanist and entomologist of the State Agricultural Experiment Station at Pullman.

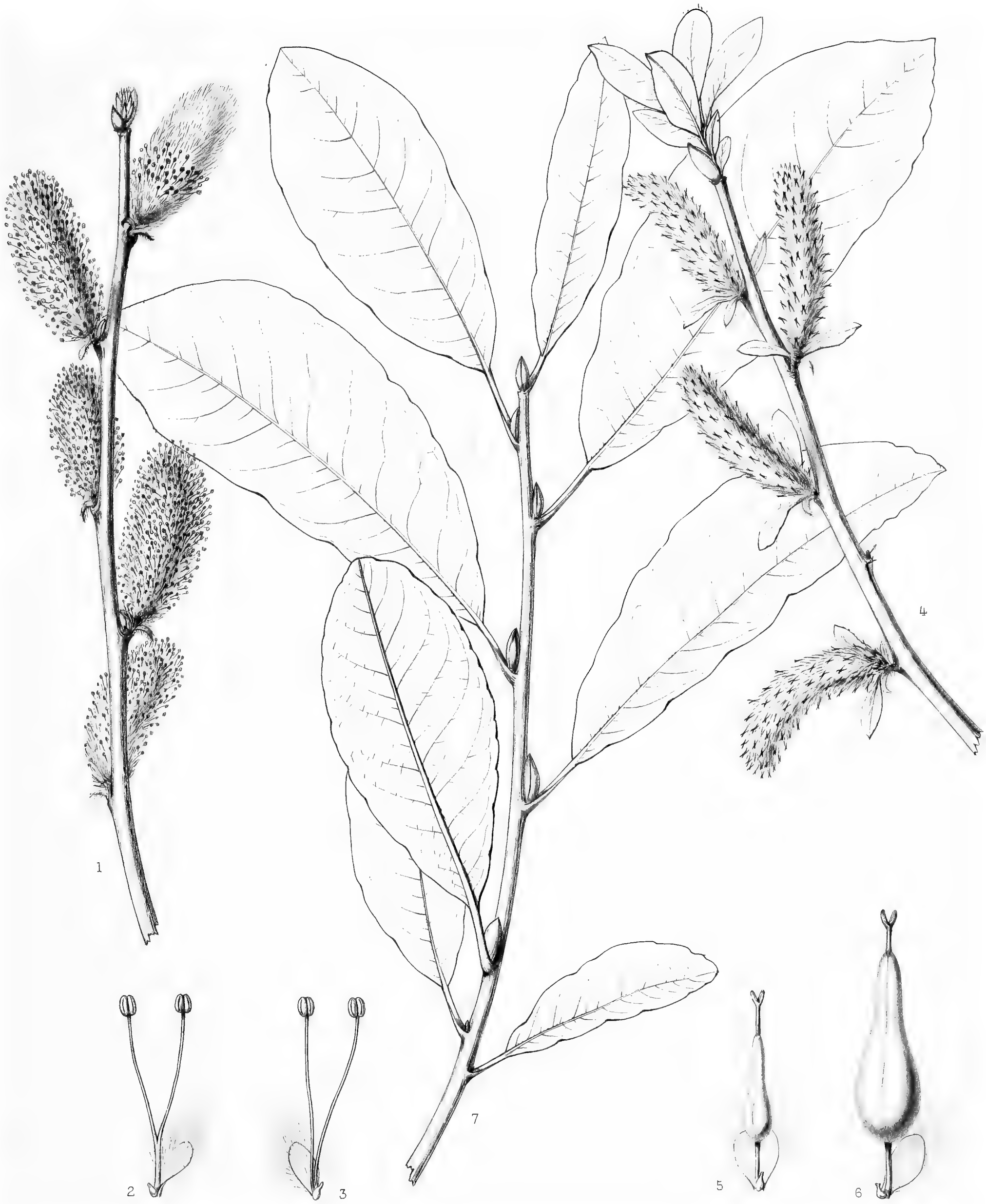
Salix Piperi, which is one of the rarest and least well known of American Willows, is, with its large white silky precocious staminate aments, its bright branches, and its large brilliantly colored leaves, one of the most distinct and beautiful among them.[1]

[1] Three plants of *Salix Piperi* are known in the vicinity of Seattle. One of them, growing on the gravelly beach at Lake Washington with *Salix cordata*, *Salix Sitchensis*, and *Salix Nuttallii*, var. *brachystachys*, is the only pistillate plant of the species that has yet been discovered, and is a shrub with stems not more than three or four feet tall. About three miles distant from it are two staminate plants, one growing in a swamp near Lake Union, and the other in a sphagnum covered bog on high ground in the same neighborhood. A third staminate plant has been found by Professor Piper several miles south of Seattle on the margin of a creek near Yalm Prairie in Thurston County, and a fourth about ten miles south of the same city. Although *Salix Piperi* is not known at present except in a shrubby form, it is admitted into *The Silva*, in which only the arborescent species are described, because many Willows are both shrubby and arborescent in habit, and therefore it is not impossible that arborescent individuals of this species may yet be found.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXXIV. SALIX PIPERI.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A staminate flower with its scale, front view, enlarged.
4. A branch of the pistillate tree, natural size.
5. A pistillate flower with its scale, front view, enlarged.
6. A capsule, enlarged.
7. A summer branch, natural size.



C.E. Faxon del. Himely sc.

SALIX PIPERI, Bebb.

A. Riocreux direx.t Imp. J. Taneur, Paris

SALIX HOOKERIANA.

Willow.

LEAVES oblong or oblong-obovate, yellow-green and glabrous or tomentose on the upper surface, pale or glaucous and tomentose on the lower.

Salix Hookeriana, Hooker, *Fl. Bor.-Am.* ii. 145, t. 180 (excl. hab. Saskatchewan) (1839). — Nuttall, *Sylva*, i. 64. — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 119 (*Bidr. Nordam. Pilarter*) (excl. hab. Saskatchewan); *Proc. Am. Acad.* iv. 59; *De Candolle Prodr.* xvi. pt. ii. 274. — Walpers, *Ann.* v. 747. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 170 (excl. hab. Saskatchewan). — Bebb, *Bot. Gazette*, xiv. 52. — Dippel, *Handb. Laubholzk.* ii. 303, f. 142. — Koehne, *Deutsche Dendr.* 93.

A tree, occasionally thirty feet in height, with a trunk a foot in diameter; more often shrubby, with numerous stems from four to eight inches thick and fifteen or twenty feet high; and frequently a low bush, with straggling almost prostrate stems. The bark of the trunk is nearly an eighth of an inch in thickness, light red-brown, slightly fissured, and divided into closely appressed plate-like scales. The branchlets are stout, marked with large scattered orange-colored lenticels, covered during their first season with thick hoary tomentum, and rather bright or dark reddish brown and pubescent in their second summer. The buds are ovate, acute, nearly terete, dark red, coated with pale pubescence, and about a quarter of an inch in length. The leaves are oblong or oblong-obovate, gradually narrowed and wedge-shaped or rounded at the base, acute or abruptly acuminate with short points or rarely rounded and frequently apiculate at the apex, and coarsely crenately serrate, especially those on vigorous shoots, or often entire; when they unfold they are villous with pale hairs or tomentose above and clothed below with thick silvery white tomentum, and at maturity they are thin and firm in texture, bright yellow-green and lustrous on the upper surface, which is glabrous with the exception of the pubescence on the stout midribs or rarely is coated until after midsummer with loose cobweb-like tomentum, and pale and glaucous on the lower surface, which is tomentose or pubescent, especially along the midribs, the slender arcuate and united primary veins, and the conspicuous reticulate veinlets; they are from two to six inches long and from an inch to an inch and a half wide, with stout tomentose petioles from one quarter to three quarters of an inch in length; those of the first pair are ovate or oblong-obovate, green and nearly glabrous on the upper surface, and covered on the lower with long white silky hairs which also form a conspicuous fringe on their margins. The aments, which appear in April, are oblong-cylindrical, erect, rather lax, often more or less curved, and are borne on short tomentose branchlets furnished with obovate acute leaves coated, especially below and along the margins, with long white or rufous hairs, and from one half to three quarters of an inch in length; they are about an inch and a half long, and those of the staminate plant are two thirds of an inch thick, and rather thicker than those of the pistillate plant, which when the capsules mature are often two and a half inches long; their scales are oblong-obovate, yellow, and coated with long pale hairs, those of the staminate ament being rounded above and rather broader than the more acute scales of the pistillate ament, which are persistent under the fruit. The stamens are two in number, with free elongated glabrous filaments. The ovary is conical, gradually narrowed above, glabrous, crowned by a slender elongated bright red style and broad spreading entire stigmas, and is raised on a slender stem about a third as long as the scale. The capsule is oblong-cylindrical, narrowed above, and about a quarter of an inch in length.

Salix Hookeriana inhabits the borders of salt-water marshes and ponds, and sandy coast-dunes, and is distributed from Vancouver's Island southward along the shores of Puget Sound and the Pacific Ocean to southern Oregon.

The wood of *Salix Hookeriana* is light, soft, and close-grained; it is light brown tinged with red, with thin nearly white sapwood, and contains thin very obscure medullary rays and numerous minute open ducts. The specific gravity of the absolutely dry wood is 0.5350, a cubic foot weighing 33.34 pounds.

Salix Hookeriana was discovered by Dr. John Scouler during his visit to the northwest coast in the years 1825–1827.[1]

[1] See Bebb, *Bot. Gazette*, xiv. 53.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXXV. SALIX HOOKERIANA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, front view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A summer branch, natural size.

C.E.Faxon del.

Rapine sc.

SALIX HOOKERIANA, Hook.

A.Riocreux direx.t

Imp. J. Taneur, Paris.

SALIX SITCHENSIS.

Willow.

LEAVES oblong-obovate to oblanceolate, usually acute or acuminate, coated below with lustrous silky white tomentum.

Salix Sitchensis, Bongard, *Mém. Phys. et Nat. Pt.* 2, *Acad. Sci. St. Pétersbourg*, ii. 162 (*Vég. Sitcha.*) (1831). — Ledebour, *Fl. Ross.* iii. 609. — Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 126 (*Bidr. Nordam. Pilarter*); *Proc. Am. Acad.* iv. 66; *Svensk. Vetensk. Akad. Handl.* ser. 4. vi. 106, f. 59 (*Monographia Salicum*) (? excl. subspec. *Ajanensis*) (1867); *De Candolle Prodr.* xvi. pt. ii. 233 (? excl. γ *Ajanensis*). — Walpers, *Ann.* v. 752. — Bebb, *Brewer & Watson Bot. Cal.* ii. 87 (excl. var. *angustifolia*); *Bot. Gazette*, vii. 25; xvi. 105. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 171. — Macoun, *Cat. Can. Pl.* 454. — Dippel, *Handb. Laubholzk.* ii. 266, f. 127. — Koehne, *Deutsche Dendr.* 103. — Greene, *Man. Bot. Bay Region*, 300. — F. Kurtz, *Bot. Jahrb.* xix. 407 (*Fl. Chilcatgebietes*).

Salix Scouleriana, Hooker, *Fl. Bor.-Am.* ii. 145 (in part) (1839).

Salix cuneata, Nuttall, *Sylva*, i. 66 (1842).

Salix Coulteri, Andersson, *Öfvers. Vetensk. Akad. Förhandl.* xv. 119 (*Bidr. Nordam. Pilarter*) (not Tuckerman) (1858); *De Candolle Prodr.* xvi. pt. ii. 264. — Bebb, *Brewer & Watson Bot. Cal.* ii. 90.

Salix Sitchensis congesta, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 107 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 233.

Salix Sitchensis denudata, Andersson, *Svensk. Vetensk. Akad. Handl.* ser. 4, vi. 107 (*Monographia Salicum*) (1867); *De Candolle Prodr.* xvi. pt. ii. 233.

A low much-branched tree, occasionally twenty-five or thirty feet in height, with a short contorted often inclining trunk sometimes a foot in diameter; or more often shrubby in habit and from six to fifteen feet in height. The bark of the trunk is about an eighth of an inch in thickness and broken into irregular closely appressed scales which are dark brown tinged with red. The branchlets are slender, coated at first with thick hoary tomentum, pubescent or tomentose and dark reddish brown or orange-color during their first year, and darker, pubescent or glabrous, and sometimes covered with a glaucous bloom in their second season. The buds are acute, nearly terete, light red-brown, pubescent or puberulous, and about a quarter of an inch in length. The leaves are conduplicate in the bud, oblong-obovate to oblanceolate, entire, or dentate with remote minute spreading glandular teeth, gradually narrowed and wedge-shaped at the base, and acute or acuminate or rounded and short-pointed or toward the base of the branchlet often rounded at the apex; when they unfold they are pubescent or tomentose on the upper surface, and coated on the lower with lustrous white silky tomentum persistent during the season or sometimes deciduous from the leaves of vigorous young shoots; and at maturity they are thin and firm in texture, dark green, lustrous and glabrous above, with the exception of the stout midribs, which are covered with pale pubescence, from two to five inches long and from three quarters of an inch to an inch and a half wide, with conspicuous slender veins arcuate and united within the margins, rather prominent reticulate veinlets, and stout pubescent grooved petioles rarely half an inch in length; the first pair of leaves are oblong-obovate, rounded at the apex, and coated with lustrous silky tomentum, and fall when less than half an inch in length. The stipules are foliaceous, semilunate, acute or rounded at the apex, glandular-dentate, coated below with hoary tomentum, often half an inch long, and usually caducous. The aments are cylindrical, densely flowered, and erect on short tomentose branches which bear small acute leaves or scale-like bracts; on the staminate plant they are from an inch and a half to nearly two inches long and half an inch broad, and on the pistillate plant from two and a half to three inches long and about a quarter of an inch broad, becoming nearly four inches in length when the capsules mature; the scales are yellow or tawny, and those of the staminate ament are oblong-obovate, rounded at the apex, covered with long white hairs, and much

longer than the more acute scales of the pistillate ament, which are clothed with short pale or rufous pubescence. The staminate flower consists of a single stamen with an elongated glabrous filament, or very rarely of two stamens with filaments united below the middle or nearly to the apex. The ovary is short-stalked, ovate, conical, acute, and gradually narrowed into the elongated style which is crowned by thick entire or slightly emarginate stigmas. The capsule is ovate, narrowed above, light reddish brown, pubescent, and about a quarter of an inch long.

Salix Sitchensis inhabits the banks of streams and other low moist situations, and is distributed from Alaska, where it was discovered by Russian collectors, southward in the neighborhood of the coast to Santa Barbara, California.

The wood of *Salix Sitchensis* is light, soft, and close-grained; it is light red, with thick nearly white sapwood, and contains numerous thin medullary rays. The specific gravity of the absolutely dry wood is 0.5072, a cubic foot weighing 31.61 pounds.

One of the most beautiful of the North American Willows with its lustrous shoots and brilliant foliage, *Salix Sitchensis* is a desirable ornamental plant, and is now occasionally cultivated in European gardens.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXXVI. SALIX SITCHENSIS.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, side view, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, front view, enlarged.
5. A fruiting branch, natural size.
6. A capsule, enlarged.
7. A summer branch, natural size.

C.E.Faxon del. *Toulet sc.*

SALIX SITCHENSIS, Bong.

A.Riocreux direx.t *Imp. J.Taneur, Paris.*

POPULUS.

FLOWERS diœcious, solitary on the stipitate variously divided scales of pendulous aments; perianth 0; disk cup-shaped, often oblique; stamens 4 to 60; ovary 1-celled; ovules numerous, ascending. Fruit a 2 to 4-valved capsule. Leaves alternate, usually ovate or ovate-lanceolate, penniveined, stipulate, deciduous.

Populus, Linnæus, *Gen.* 307 (1737). — Adanson, *Fam. Pl.* ii. 376. — A. L. de Jussieu, *Gen.* 409. — Endlicher, *Gen.* 290. — Meisner, *Gen.* 348. — Bentham & Hooker, *Gen.* iii. 412. — Baillon, *Hist. Pl.* ix. 252. — Pax, *Engler & Prantl Pflanzenfam.* iii. pt. i. 35.

Tremula, Dumortier, *Hall Bijdr. Nat. Wet.* 146 (1826). — Rafinesque, *Alsograph. Am.* 42.

Octima, Rafinesque, *Alsograph. Am.* 42 (1838).

Aigiros, Rafinesque, *Alsograph. Am.* 42 (1838).

Monilistus, Rafinesque, *Alsograph. Am.* 42 (1838).

Leuce, Opiz, *Seznam*, 59 (1852).

Large fast-growing trees, with watery juice, furrowed bark, soft straight-grained pale or rarely hard dark-colored wood, stout terete or angled branches much roughened after their first year by the enlarged and thickened leaf-scars, and thick tough and flexible frequently stoloniferous roots. Buds terminal and axillary, resinous, covered by several membranaceous scales, those of the first pair small and opposite, the others imbricated, increasing in size from below upward, accrescent, and marking the base of the branch with persistent ring-like scars.[1] Leaves involute in the bud, alternate, usually ovate or ovate-lanceolate, entire, dentate with usually glandular teeth, the glands frequently nectariferous at the base of the leaf, or lobed, penniveined, often three-nerved from the base, turning yellow and deciduous in the autumn, long-petioled, the petioles sometimes laterally compressed, those of the lower leaves furnished at the apex on the upper side with two nectariferous glands,[2] leaving when they fall oblong often obcordate elliptical arcuate or shield-shaped leaf-scars displaying the ends of three nearly equidistant fibro-vascular bundles. Stipules caducous, leaving in falling persistent scars; those of the first leaves oblong, concave, rounded at the apex, thick and firm, as large as the bud-scales, smaller higher on the branch, and on the last leaves linear-lanceolate, brown and scarious. Flowers diœcious,[3] appearing in early spring before the unfolding of the leaves in sessile or pedunculate elongated pendulous aments from separate scaly buds formed during the previous season in the axils of leaves of the year, the pistillate becoming elongated and rarely erect at maturity. Scales of the ament one-flowered, obovate, gradually narrowed into slender stipes, dilated and lobed, palmatifid or fimbriate at the apex, membranaceous, glabrous or villous, usually caducous. Disk of the flower broadly cup-shaped, often oblique, entire, dentate or irregularly lobed, fleshy or membranaceous, glabrous or rarely villous, stipitate, generally persistent under the fruit. Stamens from four to twelve or from twelve to sixty or more, inserted on the disk; filaments free, short, light yellow, glabrous; anthers ovate or oblong, attached on the back near the base, purple or red, introrse, two-celled, the cells parallel, opening longitudinally. Ovary sessile in the bottom of the disk, oblong-conical, subglobose or ovate-oblong, cylindrical or slightly lobed, glabrous or rarely villous, with two or three or rarely four parietal placentas; style short; stigmas as many as the placentas, divided into filiform lobes, or broad, dilated, two-parted or variously lobed; ovules numerous on each placenta, inserted below their middle, ascending, anatropous, short-stalked; the micropyle inferior. Capsule ripening before the full development of the leaves, greenish or reddish brown,

[1] Henry, *Nov. Act. Acad. Cæs. Leop.* xxii. 327, t. 31.

[2] Trelease, *Bot. Gazette*, vi. 284.

[3] Individual trees, bearing staminate and pistillate aments and also aments with staminate and pistillate flowers mixed together, occasionally occur in the United States. (See Davenport, *Bot. Gazette*, iii. 51. — Meehan, *Proc. Phil. Acad.* 1893, 289. — J. G. Jack, *Garden and Forest*, vii. 163.)

glabrous or villous, oblong-conical, subglobose, or ovate-oblong, one-celled, separating at maturity into from two to four thin or thick recurved valves placentiferous below the middle. Seed exalbuminous, minute, broadly obovate, or ovate, rounded or acute at the apex, surrounded by a tuft of long soft white hairs attached to the short funiculus and deciduous with it; testa light chestnut-brown. Embryo straight, filling the cavity of the seed; cotyledons elliptical, much longer than the short radicle turned toward the minute hilum.[1]

Populus inhabits boreal and temperate regions in the northern hemisphere, often in the extreme north covering great areas with nearly pure forests, and ranging southward in the New World to northern Mexico, and Lower California, where one endemic species occurs,[2] and in the Old World to northern Africa and the southern slopes of the Himalayas, upon which *Populus ciliata*[3] and *Populus microcarpa*[4] are found. Of the eighteen or nineteen species[5] which have been distinguished, nine inhabit British America and the United States, where Poplars are distributed from within the Arctic Circle to Mexico, and from the shores of the Atlantic Ocean to those of the Pacific, lining the banks of streams in the northern and central regions of the continent, and growing on high mountain slopes. In the eastern hemisphere Poplars extend north of the Arctic Circle and abound in northern and central Europe, and in northern and central Asia, where they are often the most conspicuous feature of vegetation.[6]

[1] The species of Populus may be grouped in the following sections proposed by Sereno Watson (*Am. Jour. Sci.* ser. 3, xv. 135):—

1. Stigmas two, two or three-lobed, with narrow or filiform lobes. Capsule oblong-conical, thin-walled, two-valved. Leaves ovate; petioles laterally compressed. Buds slightly resinous, glabrous or pubescent. (Sections Leuce [Duby, *De Candolle Syn. Pl. Fl. Gall.* ed. 2, i. 427 (1828)] and Leucoides [Spach, *Ann. Sci. Nat.* sér. 2, xv. 30 (1841) (*Revisio Populorum*)].)

2. Stigmas from two to four, dilated, two-lobed, their lobes variously divided. Capsule subglobose to ovate-oblong, usually thick-walled, two to four-valved. Leaves ovate, cordate, lanceolate or deltoid; petioles terete or laterally compressed. Buds very resinous. (Sections Aigeiros [Duby, *l. c.* (1828)] and Tacamahaca [Spach, *l. c.* 32 (1841)].)

[2] *Populus Monticola*, Brandegee, *Zoë*, i. 274 (1890). — Sargent, *Garden and Forest*, iv. 330, f. 56.

Populus Monticola, which is the American representative of the Old World *Populus alba*, and a tree often nearly a hundred feet in height, with a tall thick trunk, young branches and buds coated with hoary tomentum, and broadly ovate leaves covered with silky white hairs, inhabits cañons of the high mountains in the interior of southern Lower California, following them down toward the warm lowlands, where it grows to its largest size, and where it was discovered in January, 1890, by Mr. T. S. Brandegee, who found it flowering in February and losing its leaves in the early autumn months when other plants associated with it, stimulated by the late summer rains of the region, were just entering the period of active vegetation.

Unlike that of other Poplars, the wood of this noble tree is light red, hard and heavy, with a handsome satiny surface capable of receiving a high polish. (See *Garden and Forest*, vi. 190.)

[3] Royle, *Ill.* ii. 346, t. 84, f. 1 (1839). — Wesmael, *De Candolle Prodr.* xvi. pt. ii. 329; *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 243, t. 5 (*Monogr. Pop.*). — Hooker f. *Fl. Brit. Ind.* v. 638.

This is a large tree common in the mixed forests of the temperate Himalayas from Cashmere to Bhutan. Water-troughs and other articles of domestic use are made from the wood, and the leaves are used as fodder for goats (Brandis, *Forest Fl. Brit. Ind.* 476. — Gamble, *Man. Indian Timbers*, 379).

[4] Hooker f. *l. c.* 639 (1890).

[5] In addition to the species of Poplars of which several are still very imperfectly known, a number of plants believed to be hybrids have appeared at different times either naturally or as the result of artificial fecundation, and the ease with which the trees of this genus appear to intercross adds to the difficulty of understanding many of the Old World forms, which seem to be hopelessly confused. In *The Gardener's Chronicle* (n. ser. xviii. 108) five hybrid Poplars from the Forest School at Petrovskoi-Rasoumovskoi, near Moscow, are described; and hybrid Poplars are also described by Karl Koch (*Wochenschr. Gärtn. und Pflanzenk.* viii. 225), Dippel (*Handb. Laubholzk.* ii. 204, 208), and Koehne (*Deutsche Dendr.* 78, 84, 85).

[6] The two common Poplars of northeastern Asia have often been considered varieties of the North American *Populus balsamifera;* but Maximowicz, who had unrivaled opportunities for studying these trees in their native forests, considered them distinct from the New World species, owing to the form of their leaves and their sessile or subsessile capsules, and his views are probably correct, although, as he suggested, trees of this group in cultivation may have been so changed by the intercrossing of the American and Asiatic species that it is not always possible to distinguish the cultivated plants specifically (*Bull. Soc. Nat. Mosc.* liv. pt. i. 51).

The most widely distributed of these trees is, —

Populus suaveolens, Fischer, *Gartenzeit.* ix. 404 (1841). — Ledebour, *Fl. Ross.* iii. 629. — Turczaninow, *Fl. Baicalensi-Dahurica*, ii. 125. — Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 245 (*Prim. Fl. Amur.*). — Regel, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, iv. 132 (*Tent. Fl. Ussur.*); *Bull. Soc. Nat. Mosc.* xxii. pt. i. 398. — Fr. Schmidt, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, xii. 174 (*Fl. Sachalinensis*). — Koehne, *Deutsche Dendr.* 84.

Populus balsamifera, Pallas, *Fl. Ross.* i. 67, t. 41 (not Linnæus) (1784). — Hooker & Arnott, *Bot. Voy. Beechey*, 117. — Trautvetter, *Act. Hort. Petrop.* ix. 189 (*Incrementæ Fl. Ross.*) (in part). — Brandis, *l. c.* — Hooker f. *l. c.* 638.

Populus balsamifera suaveolens, Loudon, *Arb. Brit.* iii. 1674 (1838). — Wesmael, *De Candolle Prodr. l. c.* 330 (excl. hab. America); *Mém. Soc. Sci. Hainaut, l. c.* 246, t. 6. — Dippel, *l. c.* 206 (in part).

Populus pseudobalsamifera, Fischer, *l. c.* 403 (1841).

Populus is the oldest type of dicotyledonous plants yet identified, and its traces, with those of Sequoias, Pines, and Cycads, have been found in the lower cretaceous rocks of Greenland. It was common on the mid-continental plateau of North America during cretaceous times, and in Europe and North America during the tertiary epoch, and predominated in the miocene of Europe, the remains of twenty-eight species of that period having been described.[1]

The wood of Populus contains numerous small scattered open ducts. That of many of the species is suitable for paper-making,[2] and is used in large quantities in the United States and Canada for this purpose, and several species furnish wood that is employed in construction and in the manufacture of small articles, the most valuable timber-trees of the genus being the North American *Populus deltoidea*, *Populus heterophylla*, and *Populus trichocarpa*, the European and Asiatic *Populus nigra*,[3]

This large tree is distributed from northwestern India and western Thibet through western Siberia and Manchuria to Kamtschatka and to Saghalin, and northern Japan, where in southern Yezo it is sometimes a hundred feet in height, with a trunk three or four feet in diameter.

The second of these Asiatic Poplars appears to be chiefly confined to the Altai region of southern Siberia. It is:—

Populus laurifolia, Ledebour, *Fl. Alt.* iv. 297 (1833); *Icon. Fl. Ross.* t. 479; *Fl. Ross.* iii. 629. — Fischer, *Gartenzeit.* ix. 404. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 33 (*Revisio Populorum*); *Hist. Vég.* x. 394. — Dippel, *Handb. Laubholzk.* ii. 209. — Koehne, *Deutsche Dendr.* 85.

Populus balsamifera viminalis, Loudon, *Arb. Brit.* iii. 1673 (1838). — Wesmael, *De Candolle Prodr.* xvi. pt. ii. 330; *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 247, t. 7, f. 2.

Populus longifolia, Fischer, *l. c.* 403 (1841).

Populus balsamifera, β *laurifolia*, Wesmael, *De Candolle Prodr. l. c.* (1868); *Mém. Soc. Sci. Hainaut, l. c.* 246, t. 7, f. 1.

This is a tree with angled branches and rather narrow leaves. In a wild state it rarely grows, it is said, more than from thirty to forty feet in height. It is often planted as a street tree in the towns of northeastern Russia.

Many forms or perhaps hybrids of this tree, of *Populus suaveolens* and of *Populus balsamifera*, are cultivated in western Europe and have been introduced into the United States. One of them, under the name of *Populus Certinensis*, has shown remarkable power to resist drought and cold, and is considered one of the most valuable shade-trees in the region between the Great Lakes and the Rocky Mountains and northward. (See Green, *Bull. Minnesota Agric. Exper. Stat.* No. 9, 39 [*Russian Willows and Poplars*].)

[1] Newberry, *Ann. Lyc. N. Y.* ix. 60 (*Extinct Floras of North America*). — Lesquereux, *Rep. U. S. Geolog. Surv.* vii. 172, t. 22, f. 8–13, t. 23, t. 24, t. 62, f. 5, t. 64, f. 5; viii. 157, t. 30, f. 1–8, t. 38, f. 9–11 (*Fossil Fl. W. Territories*, ii., iii.); *Mem. Mus. Comp. Zoöl.* vi. pt. ii. 11, t. 8, f. 1–8 (*Fossil Plants of the Auriferous Gravel Deposits of the Sierra Nevada*). — Saporta, *Origine Paléontologique des Arbres*, 182. — Zittel, *Handb. Palæontolog.* ii. 458.

[2] Stonhill, *Rattray & Mill Forestry and Forest Products*, 437 (*History of Wood Paper*). — Spons, *Encyclopædia of the Industrial Arts, Manufactures, and Raw Commercial Products*, ii. 1493.

[3] Linnæus, *Spec.* 1034 (1753). — Willdenow, *Spec.* iv. pt. ii. 804. — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 299. — Smith & Sowerby, *English Bot.* xxvii. t. 1910. — Reichenbach, *Icon. Fl. German.* xi. 30, t. 619. — Hartig, *Forst. Culturpfl. Deutschl.* 435, t. 35. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 233. — Parlatore, *Fl. Ital.* iv. 288. — Wesmael, *De Candolle Prodr. l. c.* 327; *Mém. Soc. Sci. Hainaut, l. c.* 238, t. 19, f. 1. — Boissier, *Fl. Orient.* iv. 1194.

Populus versicolor, Salisbury, *Prodr.* 395 (1796).

Populus Neapolitana, Tenore, *Fl. Nap.* v. 279 (1836).

Populus caudina, Tenore, *l. c.* 280 (1836).

Populus nigra is a large tree of rapid growth, with erect spreading branches; it is distributed from central Europe to northern Africa, Persia, and southern Siberia, and through cultivation has become naturalized in Great Britain and southern Scandinavia (Bentham, *Ill. Handb. Brit. Fl.* ii. 770), and sparingly in North America, where the younger Michaux found it growing spontaneously on the banks of the Hudson River above Albany (*Populus Hudsonica*, Michaux f. *Hist. Arb. Am.* iii. 293, t. 10 [1813]), and Pursh on the shores of the Hudson and of Lake Ontario (*Populus betulifolia*, Pursh, *Fl. Am. Sept.* ii. 619 [1814]). It now grows on a small island in the Delaware River near Easton, Pennsylvania, where it was found by Professor Thomas C. Porter; and in the neighborhood of cities it occasionally occurs along the borders of highways apparently as an escape from cultivation.

The wood of *Populus nigra*, which is soft and splits readily, is largely used in central Europe in making packing-cases, trays, bowls, dishes, and the soles of shoes. The bark is used in tanning leather, and that from the base of old trunks for the floats of fish-nets. The vigorous young shoots sometimes replace those of the Willow in coarse baskets; the hairs which surround the seeds have been made into cloth and utilized as a substitute for cotton in wadding garments; and extracts of the balsamic buds are employed domestically in the treatment of nervous diseases. (See Loudon, *Arb. Brit.* iii. 1652.)

The most distinct in habit and the most widely spread through cultivation of all the Poplars is the tree with fastigiate branches known in the United States as the Lombardy Poplar and now usually considered a variety of *Populus nigra*. It is:—

Populus nigra Italica, Du Roi, *Harbk. Baumz.* ii. 141 (1772).

Populus Italica, Moench, *Bäume Weiss.* 79 (1785).

Populus dilatata, Aiton, *Hort. Kew.* iii. 406 (1789). — Willdenow, *l. c.* — Hayne, *Arzn.* xiii. t. 46.

Populus pyramidata, Moench, *Meth.* 339 (1794).

Populus pyramidalis, Borkhausen, *Handb. Forstbot.* i. 541 (1800). — Spach, *Hist. Vég.* x. 388. — Koch, *Syn. Fl. German.* ed. 2, 760. — Wilkomm & Lange, *l. c.* 233. — Boissier, *l. c.*

Populus fastigiata, Poiret, *Lam. Dict.* v. 235 (1804). — Desfontaines, *Hist. Arb.* ii. 465. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 399.

Populus nigra, β *pyramidalis*, Spach, *Ann. Sci. Nat. l. c.* 31 (1841). — Parlatore, *l. c.* 289. — Wesmael, *De Candolle Prodr. l. c.* 328; *Mém. Soc. Sci. Hainaut, l. c.* 239, t. 19, f. 2.

It is believed that the fastigiate Poplar originated in Afghanistan. It is said to grow wild in the forest at Shakkabad, near Cabul, at an elevation of seven thousand five hundred feet above the level of the sea; in early times it was commonly cultivated in the coun-

Populus alba,[1] and *Populus tremula*,[2] and the curiously heterophyllous African and Asiatic *Populus*

tries of western Asia, and may have been introduced into Europe by the Arabs or by some European traveler in the Orient, as it is not mentioned by Pliny and other Roman agricultural writers. (See Loudon, *Arb. Brit.* iii. 1660. — Griffith, *Ill.* i. 344. — Brandis, *Forest Fl. Brit. Ind.* 1194.) Manetti, however (*Gard. Mag.* n. ser. ii. 569), and K. Koch (*Dendr.* ii. pt. ii. 490), considered it indigenous in Lombardy.

The fastigiate Poplar is cultivated in the valleys of the northwestern Himalayas, especially in Cashmere, where it sometimes attains the height of a hundred feet, and up to elevations of twelve thousand five hundred feet in western Thibet. The date of its introduction into Europe is unknown, but, according to Loudon, it was not planted in Tuscany until 1805, a fact which confirms his belief that it was not indigenous in Italy. In 1745 a French engineer officer sent from Italy five cuttings to the director of the work on the canal at Montargis, along the banks of which it was first planted in France. (See Pelée de Saint-Maurice, *L'Art de Cultiver les Peupliers d'Italie.*) According to Aiton (*Hort. Kew.* iii. 406) it was first introduced into England about 1758 by the Earl of Rochford, British ambassador at Turin. It was brought to the United States in 1784 by Mr. William Hamilton, who introduced many foreign plants into his garden at Woodlands, near Philadelphia, which was the richest and most famous in America at the end of the last century (see Darlington, *Memorials of Bartram and Marshall*, 577); and in 1797, when Mr. John Kenrick established a nursery in Newton, Massachusetts, he devoted two acres to its cultivation, as the Lombardy Poplar was the only ornamental tree for which there was then any active demand in this country. (See *Hist. Mass. Hort. Soc.* 33.) It has since been planted all over the continent from the valley of the St. Lawrence River to Mexico; and the fact that it does not suffer from the cold of the Canadian winter indicates that this tree originated in a climate much more severe than that of northern Italy.

The wood of the Lombardy Poplar is considered less valuable than that of *Populus nigra*, although it is occasionally employed in southern Europe for packing-cases and small articles of domestic use.

The Lombardy Poplar has been more generally planted on the borders of highways in central and southern Europe than any other tree. No other can send up so rapidly a tall slender shaft, and to break a low or monotonous sky-line it is invaluable; but used as it has been in all sorts of situations, without regard to its surroundings, and in long formal avenues, it has done more perhaps than any other tree to disfigure the landscape in many parts of France and Germany.

In the United States the Lombardy Poplar is now a short-lived tree. Insects boring into the trunk and branches often kill it; and as it is also affected by fungal diseases here and in Europe, it is now much less generally planted than it was a century ago.

[1] Linnæus, *Spec.* 1034 (1753). — Desfontaines, *Fl. Atlant.* ii. 368. — Willdenow, *Spec.* iv. pt. ii. 802. — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 298. — *Nouveau Duhamel*, ii. 181, t. 52. — Smith & Sowerby, *English Bot.* xxiii. t. 1618. — Guimpel, Willdenow & Hayne, *Abbild. Deutsche Holz.* 265, t. 202. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 29 (*Revisio Populorum*); *Hist. Vég.* x. 379. — Reichenbach, *Icon. Fl. German.* xi. 29, t. 614. — Hartig, *Forst. Culturpfl. Deutschl.* 433, t. 32. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 233. — Parlatore, *Fl. Ital.* iv. 280. — Wesmael, *De Candolle Prodr.* xvi. pt. ii. 324; *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 225, t. 1, 2 (*Monogr. Pop.*). — Boissier, *Fl. Orient.* iv. 1193. — Hooker f. *Fl. Brit. Ind.* v. 638.

Populus major, Miller, *Dict.* ed. 8, No. 4 (1768).

Populus nivea, Willdenow, *Berl. Baumz.* 227 (1796).

The Abele or White Poplar, as *Populus alba* is usually called, is a tree sometimes nearly a hundred feet in height, with a trunk three or four feet in diameter, light yellow-gray or ash-colored bark, except at the base of old stems, where the bark is dark and deeply furrowed, and young branches, buds, and petioles covered, like the under surface of the orbicular or broadly ovate leaves, with thick hoary tomentum. It inhabits the borders of streams and open moist woods, spreading rapidly by long vigorous stoloniferous roots, and is distributed from eastern and southern England all over central and southern Europe to northern Africa, western Siberia, Syria, Asia Minor, and the foothills of the northwestern Himalayas. It has been largely planted in Europe, western Asia, and eastern America, and in the New World has become sparingly naturalized from the valley of the lower St. Lawrence River to northern Alabama.

Several varieties of *Populus alba* are cultivated, the most distinct being a tree with fastigiate branches (*Populus alba*, var. *Bolleana*, Masters, *Gard. Chron.* n. ser. xviii. 556, f. 96 [1882]. *Populus Bolleana*, Lauche, *Deutsche Garten*, 1878, 500; *Deutsche Dendr.* ed. 2, 315. *Populus alba*, β *pyramidalis*, Dippel, *Handb. Laubholzk.* ii. 191 [1892]) sent by General Korolkow from Tashkend in Turkestan to Berlin in 1875, and now a common inhabitant of gardens in the eastern United States and Europe.

The Gray Poplar, a larger tree with smaller less deeply lobed and darker leaves, inhabits the same region as the White Poplar and is equally abundant, and by many authors has been considered a true species (*Populus canescens*, Smith, *Fl. Brit.* iii. 1080 [1804]. — Willdenow, *l. c.* — De Candolle, *l. c.* — Guimpel, Willdenow & Hayne, *l. c.* 262, t. 201. — Reichenbach, *l. c.* 30, t. 617. — Spach, *Ann. Sci. Nat. l. c.; Hist. Vég. l. c.* 381. — Willkomm & Lange, *l. c.* — Parlatore, *l. c.* 282. — Dippel, *l. c.* ii. 192).

By other authors the Gray Poplar is considered a hybrid between *Populus alba* and *Populus tremula* (*Populus hybrida*, Marschall von Bieberstein, *Fl. Taur.-Cauc.* ii. 423 [1808]. — Wesmael, *De Candolle Prodr. l. c.* 325; *Mém. Soc. Sci. Hainaut, l. c.* 228, t. 18, f. 1. *Populus albo-tremula*, Krause, *Jahrb. Schles. Gesell.* 1848, 130. *Populus alba* × *tremula*, b *canescens*, Koehne, *Deutsche Dendr.* 79 [1893]); and it has also been regarded as merely a variety of the Abele (*Populus alba*, β, Lamarck, *Fl. Franç.* ii. 235 [1778]. — Bentham, *Ill. Handb. Brit. Fl.* ii. 769).

[2] Linnæus, *l. c.* (1753). — Willdenow, *l. c.* 803. — De Candolle, *l. c.* 299. — Smith & Sowerby, *l. c.* t. 1909. — Guimpel, Willdenow & Hayne, *l. c.* 266, t. 203. — Spach, *Ann. Sci. Nat. l. c.* 29; *Hist. Vég. l. c.* 382, t. 152. — Ledebour, *Fl. Ross.* iii. 627. — Reichenbach, *l. c.* t. 618. — Hartig, *l. c.* 434, t. 34. — Turczaninow, *Fl. Baicalensi-Dahurica*, ii. 125. — Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 245 (*Prim. Fl. Amur.*); *Bull. Soc. Nat. Mosc.* liv. pt. i. 49. — Regel, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, iv. 132 (*Tent. Fl. Ussur.*). — Willkomm & Lange, *l. c.* — Parlatore, *l. c.* — Wesmael, *De Candolle Prodr. l. c.; Mém. Soc. Sci. Hainaut, l. c.* 229, t. 18, f. 2, 3, 4. — Fr. Schmidt, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, xii. 174 (*Fl. Sachalinensis*). — Franchet & Savatier, *Enum. Pl. Jap.* i. 463. — Boissier, *l. c.* — Franchet, *Nouv. Arch. Mus.* sér. 2, v. 284 (*Pl. David.* i.). — Herder, *Act. Hort. Petrop.* xi. 460 (*Pl. Radd.*). — Miyabe, *Mem. Bost. Soc. Nat. Hist.* iv. 260 (*Fl. Kurile Islands*).

? *Populus Græca*, Aiton, *Hort. Kew.* iii. 407 (1789). — Willdenow, *l. c.*

Euphratica.[1] The bark of Populus contains tannic acid, and that of several of the species is employed in Europe in tanning leather;[2] in the United States Populus bark, in which populin,[3] a crystalline principle, occurs, is occasionally used as a tonic[4] and in homœopathic practice.[5] The fragrant balsam in the buds of several species, which is readily separated by boiling, is occasionally used medicinally as a tincture for its reputed tonic and stimulant properties,[6] and by distillation yields a colorless oil of pleasant odor.[7]

Numerous insects[8] prey upon Populus and several of the species suffer seriously from attacks of

Populus australis, Tenore, *Syll. Fl. Neap.* 482 (1831); *Fl. Nap.* v. 278. — Gussone, *Enum. Pl. Ins. Inar.* 310.

Populus Sieboldi, Miquel, *Ann. Mus. Lugd. Bat.* iii. 29 (*Prol. Fl. Jap.*) in part (*teste* Maximowicz, *Bull. Soc. Nat. Mosc.* liv. pt. i. 49) (1867).

Populus tremula, the Aspen or Trembling Poplar, is a tree sixty or seventy feet in height, with vigorous stoloniferous roots, smooth bark, slender branches, and small glabrous or pubescent nearly orbicular leaves which are borne on long slender petioles and flutter with the slightest breath of air. It inhabits plains and mountain sides, usually in humid soil, and is more common at the north, where it is generally gregarious, than at the south; it is found from the Arctic Circle to northern Africa, and from the shores of the Atlantic Ocean to Asia Minor, and through Siberia, where it often covers large areas, to Kamtschatka, northern China, northern Japan, where it is common on gravelly plains and usually of small size, and the Kurile Islands, the variety *villosa*, Wesmael (*De Candolle Prodr.* xvi. pt. ii. 325 [1868]; *Mém. Soc. Sci. Hainaut*, sér. iii. 321. *Populus villosa*, Lang, *Reichenbach Fl. German. Excurs.* 173 [1832]), being the common form of western Asia.

In Europe the wood of *Populus tremula* is used in the manufacture of matches and paper; the bark is employed in tanning leather, and the young shoots and leaves are fed to cattle and goats (Loudon, *Arb. Brit.* iii. 1645, f. 1509. — Mathieu, *Fl. Forestière*, ed. 3, 422).

In gardens a form of the Aspen with long pendulous branches is often cultivated (*Populus tremula pendula*, Loudon, *l. c.* 1646 [1838]. — Wesmael, *De Candolle Prodr. l. c; Mém. Soc. Sci. Hainaut, l. c.* — Dippel, *Handb. Laubholzk.* ii. 197. *Populus pendula*, Burgsdorf, *Anleit. Anpfl.* pt. ii. 175 [1787]).

[1] Olivier, *Voyage*, iii. 449; Atlas, t. 45, 46 (1807). — Regel, *Act. Hort. Petrop.* vi. 473. — Krémer, *Descrip. Populus Euphratica*, t. 1–3. — Trautvetter, *Bull. Soc. Nat. Mosc.* xl. pt. ii. 91 (*Enum. Pl. Songor.*); *Act. Hort. Petrop.* i. 281 (*Pl. Turcom.*); ii. 589 (*Pl. Radd.*); ix. 190 (*Incrementæ Fl. Ross.*). — Wesmael, *De Candolle Prodr. l. c.* 326; *Mém. Soc. Sci. Hainaut, l. c.* 234, t. 10–13. — Boissier, *Fl. Orient.* iv. 1194. — Franchet, *Ann. Sci. Nat.* sér. 6, xviii. 253 (*Pl. Turkestan*). — Hooker f. *Fl. Brit. Ind.* v. 638. — Lace & Hemsley, *Jour. Linn. Soc.* xxviii. 309 (*Sk. Veg. Brit. Baluchistan*).

Populus biformis, Rafinesque, *Alsograph. Am.* 43 (1838).

Populus diversifolia, Schrenk, *Bull. Acad. Sci. St. Pétersbourg*, x. 253 (1842). — Fischer & Meyer, *Enum. Alt. Pl. Nov. Schrenk*, 15. — Ledebour, *Fl. Ross.* iii. 627.

Populus Euphratensis, *Gard. Chron.* 1849, 806.

Populus Euphratica, which is believed to be the Garab-tree of the Arabs, the Weeping Willow of the Psalmist upon which the Jews hung their harps (see Ascherson, *Adansonia*, x. 348), is a large tree remarkable for the variability of the shape of its leaves, which on seedlings, young trees, and vigorous shoots are linear, and on older branches broad and ovate, rhomboid or cordate; it inhabits the banks of streams, where it is often gregarious, from the province of Oran in Algeria westward through Egypt, Palestine, Syria, and northern Persia, to northwestern India, western Thibet, where it ascends to elevations of thirteen thousand five hundred feet above the level of the ocean, Turkestan, and southern Siberia.

In India the wood is used in turnery, in Sindh being made into boxes and lacquer-ware; on the Euphrates it is said to be employed in boat-building, and in Sindh and Thibet it serves as fuel; the bark is employed as a febrifuge, and the twigs are used as tooth-sticks by the Hindus; the coppice shoots, which are produced for a long time with great vigor, are sometimes used for rafters. The leaves furnish forage for goats and cattle. (See Brandis, *Forest Fl. Brit. Ind.* 474. — Gamble, *Man. Indian Timbers*, 378. — Balfour, *Cyclopædia of India*, ed. 3, iii. 262.) It is this tree and the Date Palm which are believed to have furnished the rafters for the buildings of Nineveh; and it is still used for rafters in Kurdistan, the trunks being floated down the Khabour and Tigris. (See Layard, *Nineveh and its Remains* ii. 259.)

[2] Wehrs, *Ueber Eichenlohsurrogate*, 66. — Neubrand, *Die Gerbrinde*, 220. — Höhnel, *Die Gerberinden*, 20.

[3] Braconnot, *Ann. Chim. et Phys.* xliv. 296.

[4] A. Richard, *Hist. Mat. Med.* ed. 3, iii. 187. — Johnson, *Man. Med. Bot. N. Am.* 254. — *U. S. Dispens.* ed. 16, 1897.

[5] Millspaugh, *Am. Med. Pl. in Homœopathic Remedies*, ii. 162.

[6] The buds of several of the species have been employed in the treatment of pectoral, nephritic, and rheumatic complaints, and those of *Populus nigra* were one of the ingredients of the *Unguentum populeum*, an anodyne ointment of the old European pharmacopœias.

[7] Spons, *Encyclopædia of the Industrial Arts, Manufactures, and Raw Commercial Products*, ii. 1427.

[8] In the Fifth Report of the United States Entomological Commission, published in 1890, Packard enumerates one hundred and eight species of insects found living upon Populus in North America, and further study will no doubt greatly increase this number. Many of the species which feed upon Salix are also found upon Populus, although as compared with Salix the trunks and branches seem much more liable to serious damage by borers, several species of wood destroyers being known on the Poplars. Among Coleopterous borers, *Saperda calcarata*, Say, is one of the most destructive, its large white fleshy larvæ sometimes completely riddling the trunks with their burrows and causing the death of the tree. Both indigenous and exotic Poplars are attacked by them, and other species of Saperda affect the trunk and limbs. The larvæ of *Prionus laticollis*, Drury, a common large black beetle, are often abundant in the roots and lower parts of the trunks, and *Plectrodera scalator*, Fabricius, is also said to bore into the roots. Species of Oberea are found in the twigs, and *Mecas inornata*, Say, by boring into small trunks and branches, causes them to become much swollen. The imported Willow borer, *Cryptorhynchus Lapathi*, Linnæus, has been found on Populus in America, and may become troublesome.

In some localities Lepidopterous borers have been found to infest

borers in the living trunks and branches. It is also subject to numerous fungal diseases,[1] although in North America the trees of this genus are more injured by insects than by fungi, of which only a species of Fusicladium appears capable, so far as is now known, of seriously affecting them.

Many of the species of Populus are planted as ornamental trees and for screens and wind breaks, the rapidity of their growth and the ease with which they can be propagated by cuttings making them valuable for such purposes.[2]

Populus, the classical name of the Poplar, of obscure derivation, was adopted by Tournefort[3] and other pre-Linnæan authors for this genus.

Poplars seriously; and *Cossus Centerensis*, Lintner, has done much harm to *Populus tremuloides* and *Populus balsamifera*, as their larvæ live in the trunks of these trees. Other species of this genus or of allied genera have also been found on Poplars in different parts of the country.

Among foliage destroyers one of the most serious pests is a leaf-beetle, *Lina scripta*, Fabricius, which in several of the western and southwestern states has been destructive to Poplar-trees by annually defoliating them and thus finally causing their death. *Lina Tremulæ*, Fabricius, is also sometimes common. *Chrysomela pallida*, Say, *Crepidodera Helxines*, Linnæus, and other beetles or their larvæ likewise feed on the foliage. Various species of Saw-fly larvæ feed on the Poplars and are liable to injure them. Among Lepidoptera, the larvæ of *Acronycta Populi*, Riley, frequently strip Poplars of their leaves, and other species of Acronycta are common on them. Of other Noctuidæ the genera Apatela and Catocala are represented on Populus by numerous species, but are rarely abundant enough to be noticeable. Species of Orgyia or Tussock Caterpillars are sometimes troublesome; and Clisiocampas and Hyphantria sometimes defoliate these trees in the southwestern states and territories.

The leaves are often mined by the minute larvæ of *Lithocolletis populiella*, Chambers, *Phyllocnistis populiella*, Chambers, and other Tineidæ, and the larvæ of other species sometimes roll or twist the leaves or their edges.

Aphids are frequent on these trees, and galls formed by different species of the genus Pemphigus are often abundant, sometimes occurring as peculiar wrinklings or twistings of the leaves or as more or less spherical or hemispherical formations on the leaf-blades or leaf-stalks.

[1] The most serious fungal disease of Populus in the United States is probably due to the attacks of a fungus originally described by Libert as *Oidium radiosum*, and recently redescribed by Frank as *Fusicladium Tremulæ*. It is related to the fungi which cause the breaking and cracking of pears and apples, and is common on *Populus tremuloides*, having been observed twenty years ago on a tree in the Arnold Arboretum; it is said to occur also on *Populus balsamifera* in the northeastern states. The disease manifests itself by the blackening in early summer of the young branchlets and leaves, which have the appearance of being killed by frost. No remedy for it has proved effectual, although it is evidently for the advantage of the tree to remove the blackened branchlets as soon as they are seen.

A very curious and beautiful fungus, *Taphrina rhizophora*, Johanson, attacks the young ovaries of *Populus tremuloides* and *Populus grandidentata* in the early spring, and has also been reported on *Populus nigra Italica* and *Populus Fremontii* in the United States. The ovaries affected by it are much enlarged and turn a golden yellow, so that the ament seen from a distance resembles a flowering raceme of Laburnum.

The leaves of Populus are attacked in North America by a number of species of fungi. *Uncinula Salicis*, Winter, the common mildew on the leaves of Willows, is likewise known on those of several species of Populus, which are also frequently attacked by Rusts belonging to the genus Melampsora, whose uredo condition appears as yellow spots on the leaves in summer and their teleutosporic condition as dark spots on the fallen leaves of winter and early spring. Another leaf fungus, *Glœosporium Populi*, Desmazières & Montagne, is occasionally found on *Populus alba* and other species in the United States.

The trunks and branches of Poplars are infested by a number of Ascomycetous fungi, *Valsa nivea*, Fries, being especially common on branches of *Populus tremuloides*, which are often covered by the white mouths of the perithecia. *Nœmaspora chrysosperma*, Persoon, abounds on *Populus tremuloides* and *Populus nigra Italica*, appearing as small particles from which protrude minute yellow tendrils. *Hypoxylon pruinatum*, Cooke, covers large patches of the trunks of *Populus tremuloides* with its flat ashy gray tubercles. Of Hymenomycetous fungi peculiar to Populus in this country, *Corticium pezizoideum*, Schrenk, frequently covers the branches of *Populus tremuloides* and *Populus grandidentata* with circular cushions of a deep red color.

[2] Wesmael, *Bull. Féd. Soc. Hort. Belg.* 1861, 335 (*Monogr. Pop.*). — Bailey, *Bull. Cornell University Agric. Exper. Stat.* No. 68 (*The Cultivated Poplars*).

[3] *Inst.* 592, t. 365.

CONSPECTUS OF THE NORTH AMERICAN SPECIES.

Stigmas 2, 2-lobed, their lobes filiform; capsule oblong-conical, thin-walled, 2-valved; leaves ovate; petioles elongated, compressed laterally; buds slightly resinous, glabrous or pubescent.

Leaves ovate or semiorbicular, short-pointed, slightly cordate or truncate at the base, finely serrate; buds usually glabrous . . . . . 1. P. TREMULOIDES.

Leaves broadly ovate, coarsely crenate, coated at first with hoary tomentum; buds tomentose . 2. P. GRANDIDENTATA.

Stigmas from 2 to 4, 2-lobed and dilated, the lobes variously divided; capsule subglobose to ovate-oblong, usually thick-walled, 2 to 4-valved; leaves ovate, cordate, lanceolate or deltoid; petioles terete or laterally compressed; buds very resinous.

Leaves broadly ovate, acute, short-pointed or rounded at the apex, crenately serrate; petioles terete . . . . . 3. P. HETEROPHYLLA.

Leaves ovate-lanceolate, acute or acuminate, dark green and lustrous on the upper surface, pale and often ferrugineous on the lower . . . . . 4. P. BALSAMIFERA.

Leaves ovate or lanceolate, green on both surfaces . . . . . 5. P. ANGUSTIFOLIA.

Leaves usually broadly ovate, acuminate, rounded or cordate at the broad base, dark green on the upper surface, pale, ferrugineous or silvery on the lower; ovaries tomentose . . . . . 6. P. TRICHOCARPA.

Leaves deltoid or broadly ovate, usually abruptly acuminate, coarsely crenate; petioles laterally compressed . . . . . 7. P. DELTOIDEA.

Leaves deltoid or reniform, usually short-pointed at the apex, coarsely and irregularly crenately serrate; petioles laterally compressed . . . . . 8. P. FREMONTII.

POPULUS TREMULOIDES.

Aspen. Quaking Asp.

LEAVES ovate or semiorbicular, short-pointed, slightly cordate or truncate at the base, finely serrate; petioles elongated, compressed.

Populus tremuloides, Michaux, *Fl. Bor.-Am.* ii. 243 (1803). — *Nouveau Duhamel*, ii. 184, t. 53. — Persoon, *Syn.* ii. 623. — Desfontaines, *Hist. Arb.* ii. 465. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 399. — Michaux f. *Hist. Arb. Am.* iii. 285, t. 8, f. 1. — Willdenow, *Enum.* Suppl. 67. — Bigelow, *Fl. Boston.* 241. — Poiret, *Lam. Dict.* Suppl. iv. 377. — Hooker, *Fl. Bor.-Am.* ii. 154. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 30 (*Revisio Populorum*); *Hist. Vég.* x. 384. — Torrey, *Fl. N. Y.* ii. 214; *Bot. Wilkes Explor. Exped.* 468. — Nuttall, *Sylva*, i. 55. — Seringe, *Fl. des Jard.* ii. 56. — Darlington, *Fl. Cestr.* ed. 3, 281. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 25, 89. — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 29, 68; *Am. Nat.* iii. 409. — Wesmael, *Bull. Féd. Soc. Hort. Belg.* 1861, 322, f. 2 (*Monogr. Pop.*); *De Candolle Prodr.* xvi. pt. ii. 325; *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 231, t. 3 (*Monogr. Pop.*). — Watson, *King's Rep.* v. 327; *Pl. Wheeler*, 17; *Am. Jour. Sci.* ser. 3, xv. 135. — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* No. 4, 129. — Brewer & Watson, *Bot. Cal.* ii. 91. — Rothrock, *Wheeler's Rep.* vi. 51, 242. — Beal, *Am. Nat.* xv. 32, f. 1. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 171. — Millspaugh, *Am. Med. Pl. in Homœopathic Remedies*, ii. 162, t. — Coulter, *Man. Rocky Mt. Bot.* 339. — Mayr, *Wald. Nordam.* 287. — Watson & Coulter, *Gray's Man.* ed. 6, 486. — Dippel, *Handb. Laubholzk.* ii. 197, f. 94. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 419 (*Man. Pl. W. Texas*). — Coville, *Contrib. U. S. Nat. Herb.* iv. 200 (*Bot. Death Valley Exped.*).

Populus tremula, var., Burgsdorf, *Anleit. Anpfl.* pt. ii. 174 (1787).

Populus trepida, Willdenow, *Spec.* iv. pt. ii. 803 (1805). — Aiton, *Hort. Kew.* ed. 2, v. 395. — Pursh, *Fl. Am. Sept.* ii. 618. — Nuttall, *Gen.* ii. 239. — Sprengel, *Syst.* ii. 244. — Loudon, *Arb. Brit.* iii. 1649, f. 1510.

Populus tremuliformis, Emerson, *Trees Mass.* 243 (1846); ed. 2, i. 279, t.

Populus Atheniensis, K. Koch, *Dendr.* ii. pt. i. 486 (in part) (1872). — Koehne, *Deutsche Dendr.* 80.

Populus Græca, Lauche, *Deutsche Dendr.* ed. 2, 316 (not Aiton) (1883).

Populus tremuloides, α **pendula**, Dippel, *Handb. Laubholzk.* ii. 198 (1892).

A tree, often a hundred feet in height, with a trunk which occasionally is almost three feet through near the ground, but in general is not more than eighteen or twenty inches in diameter, and preserves its size with little diminution for fifty feet or more, and with slender, remote, and often contorted branches somewhat pendulous toward their extremities, forming a narrow symmetrical round-topped head. The bark near the base of old trees is nearly black, from one to two inches in thickness, deeply divided into broad flat ridges broken on the surface into small appressed plate-like scales; higher on the trunk and on young stems it is much thinner, pale yellow-brown, orange-green, or nearly white, often roughened with interrupted horizontal bands of circular wart-like excrescences and frequently marked below the branches with large nearly black raised lunate scars. The branchlets are slender and covered with scattered oblong orange-colored lenticels, and when they first appear are clothed with caducous pale hairs; during their first year they are bright red-brown and very lustrous, but gradually turn a light gray tinged with red and then become dark gray, and for two or three years are much roughened by the large elevated leaf-scars. The leaf-buds are slightly resinous, conical, acute, slightly incurved, about a quarter of an inch in length, narrower than the more obtuse flower-buds, and covered with six or seven lustrous glabrous red-brown scales scarious on the margins, and more or less tinged with green and sometimes puberulous toward the base, the lowest emarginate. The leaves are ovate or semiorbicular, three-nerved, abruptly narrowed at the apex into short broad points, and regularly serrate with small incurved callous gland-tipped teeth except at the broad slightly cordate truncate or rarely wedge-shaped base; when they unfold they are glabrous, light green and lustrous, and ciliate

on the margins with long pale caducous hairs, and at maturity are thin and firm in texture, dark green and lustrous on the upper surface, pale dull yellow-green on the lower, and from an inch and a half to two inches in length and breadth, with yellow nerves raised and rounded on the upper side and slender veins forked and united near the margins and connected by reticulate veinlets more prominent above than below; they are borne on slender yellow petioles compressed laterally and from an inch and a half to three inches in length, and turn bright clear yellow in the autumn before falling, when they leave small three-lobed leaf-scars. The stipules of the first leaves resemble the inner bud-scales; higher on the branch they are linear-lanceolate, white and scarious, about half an inch long, and caducous. The flower aments appear in very early spring and vary from one and a half to two and a half inches in length; their scales are deeply divided into from three to five linear acute lobes fringed with long soft gray hairs. The stamens vary from six to twelve in number, and are inserted on the disk, which is oblique, with entire margins. The ovary is conical, crowned by a short thick style and two erect stigmas thickened and club-shaped below and divided above into linear divergent lobes, and surrounded at the base by the broad oblique slightly crenate disk, which is persistent under the fruit. The capsules mature in May and June, when the fruiting ament, which has a slender pubescent or tomentose rachis, is about four inches in length; they are oblong-conical, light green, thin-walled, and nearly a quarter of an inch long. The seeds are obovate, light brown, about one thirty-second of an inch in length, and surrounded with long soft snowy white hairs.

Populus tremuloides, which is the most widely distributed tree of North America, ranges from southern Labrador to the southern shores of Hudson's Bay, thence northwesterly nearly to the mouth of the Mackenzie River and the valley of the Yukon River in Alaska,[1] southerly through the northern states to the mountains of Pennsylvania, northeastern Missouri[2] and southern Nebraska,[3] and through all the mountain regions of the west, where it often ascends to elevations of ten thousand feet above the level of the sea, to the Sierras of central California,[4] northern Arizona and New Mexico, the high mountain ranges of Chihuahua, and San Pedro Martir Mountain in Lower California.[5] The Aspen rarely exceeds a height of fifty feet in eastern Canada and the northeastern states, where it is a generally distributed and common tree, preferring rather moist sandy soil and gravelly hillsides and growing most luxuriantly near the borders of swamps and open forest glades. On the western margin of the Atlantic forest north of the forty-ninth degree of latitude it grows beyond the Spruces and Larches of the east, and borders the mid-continental prairie region with a belt of varying width; in this prairie region, outside the river-valleys, which it does not enter, the Aspen grows with its greatest vigor and to its largest size, indicating by its presence soil suitable to the production of cereal crops; farther to the northwest it forms with the Birch and the Spruce the forests of the high ridges, but does not invade the flood plain of rivers or their islands.[6] In the west and southwest it grows, on the high slopes of mountains and along the banks of streams, and is usually not large, although individuals a hundred feet tall sometimes occur.[7]

The wood of *Populus tremuloides* is close-grained but soft, and neither strong nor durable; it contains numerous very thin hardly distinguishable medullary rays and numerous minute scattered open ducts, and is light brown, with nearly white sapwood composed of from twenty-five to thirty layers of annual growth, and sometimes six or seven inches in thickness. The specific gravity of the absolutely dry wood is 0.4032, a cubic foot weighing 25.13 pounds. In the east it is largely manufactured into wood-pulp for the manufacture of paper, and in the west is occasionally employed for flooring and in

[1] Provancher, *Flore Canadienne*, ii. 532. — Brunet, *Cat. Vég. Lig. Can.* 55. — G. M. Dawson, *Can. Nat.* n. ser. ix. 331. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 45°. — Macoun, *Cat. Can. Pl.* 456.

[2] Bush, *Rep. State Hort. Soc. Missouri*, 1895, 360.

[3] Bessey, *Rep. State Board Agric. Nebraska*, 1894, 103.

[4] Hansen, *Flora of the Sequoia Region*, 11.

[5] Brandegee, *Zoë*, iv. 209.

[6] Macoun, *Trans. Roy. Soc. Can.* xii. 6.

[7] On the slopes of the San Francisco Mountains in northern Arizona, at elevations of seven or eight thousand feet above the level of the sea, Aspens nearly a hundred feet in height with gleaming white trunks from two to three feet in diameter near the ground are not uncommon.

turnery. In northern British America it is the principal fuel of the Indians, and, as it burns freely while green and without sparks, is used in the open fireplaces at the posts of the Hudson Bay Company.[1] The sweet inner bark in early spring is used as food by the Indians of the north.[2]

The great value of the Aspen lies in the power of its small seeds, supported by their long hairs and wafted far and near by the wind, to germinate quickly in soil which fire has rendered infertile, and in the ability of the seedling plants to grow rapidly in exposed situations. Preventing the washing away of the soil from steep mountain slopes and affording shelter for the young of longer-lived trees, it has played a chief part in determining the composition and distribution of the subalpine forests of western America, and in recent years it has spread over vast areas of the slopes of the Rocky Mountains from which fire had swept the coniferous trees.

Populus tremuloides, which in habit and general appearance resembles the Old World *Populus tremula*, was introduced into English gardens by Frederick Pursh[3] in 1812,[4] but is probably rarely cultivated.

A graceful tree with its slender pendulous branches, shimmering leaves, and pale bark, the Aspen enlivens the Spruce forests of the north, and marks steep mountain slopes with broad bands of color, light green during the summer and in autumn glowing like gold against backgrounds of dark cliffs and stunted Pines.

[1] Richardson, *Franklin Jour.* Appx. No. 7, 766 (*Populus trepida*); *Arctic Searching Exped.* ii. 315.

[2] See Holmes, *Am. Jour. Pharm.* lvi. 619.

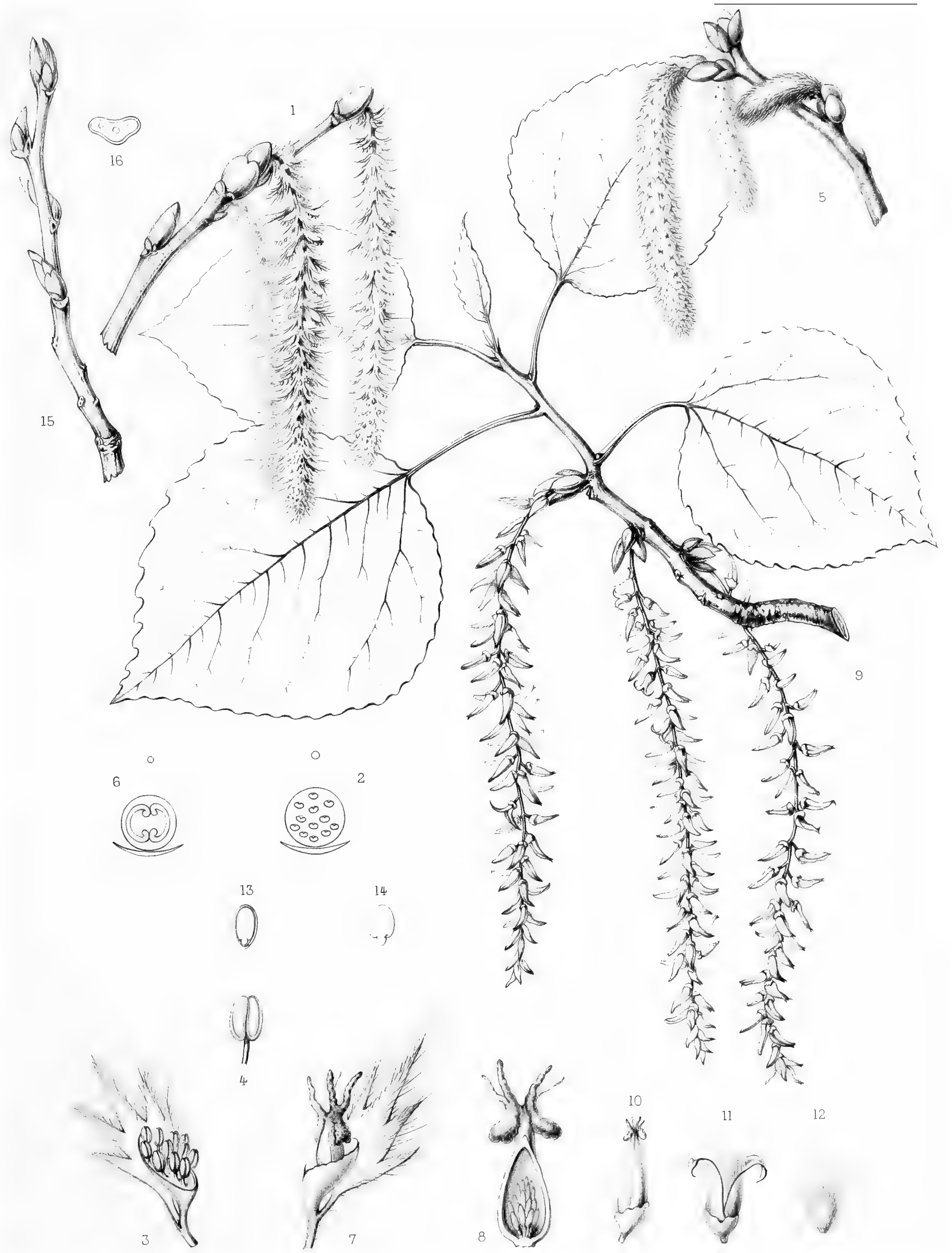
[3] See ii. 39.

[4] Aiton, *Hort. Kew.* ed. 2, v. 395.

EXPLANATION OF THE PLATE.

Plate CCCCLXXXVII. Populus tremuloides.

1. A flowering branch of the staminate tree, natural size.
2. Diagram of a staminate flower.
3. A staminate flower with its scale, enlarged.
4. A stamen, enlarged.
5. A flowering branch of the pistillate tree, natural size.
6. Diagram of a pistillate flower.
7. A pistillate flower with its scale, enlarged.
8. Vertical section of a pistil, enlarged.
9. A fruiting branch, natural size.
10. A fruit, enlarged.
11. A fruit with open valves, enlarged.
12. A seed, magnified.
13. Vertical section of a seed, magnified.
14. An embryo, magnified.
15. A winter branch, natural size.
16. A leaf-scar, enlarged.



C.E.Faxon del.

Migneaux sc.

POPULUS TREMULOIDES, Michx.

A. Riocreux direxit.

Imp. J. Taneur, Paris.

POPULUS GRANDIDENTATA.

Poplar.

LEAVES broadly ovate, coarsely crenate, coated at first, like the buds, with hoary tomentum; petioles elongated, laterally compressed.

Populus grandidentata, Michaux, *Fl. Bor.-Am.* ii. 243 (1803). — Persoon, *Syn.* ii. 624. — Desfontaines, *Hist. Arb.* ii. 466. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 400. — Michaux f. *Hist. Arb. Am.* iii. 287, t. 8, f. 2. — Pursh, *Fl. Am. Sept.* ii. 619. — Bigelow, *Fl. Boston.* 241. — Poiret, *Lam. Dict.* Suppl. iv. 377. — Nuttall, *Gen.* ii. 239. — Hayne, *Dendr. Fl.* 200. — Elliott, *Sk.* ii. 710. — Sprengel, *Syst.* ii. 244. — Tausch, *Flora,* xxi. pt. ii. 753 (*Dendr. Exot.-Bohem.*). — Hooker, *Fl. Bor.-Am.* ii. 154. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 33 (*Revisio Populorum*); *Hist. Vég.* x. 384. — Torrey, *Fl. N. Y.* ii. 214, t. 121. — Emerson, *Trees Mass.* 242; ed. 2, i. 278, t. — Seringe, *Fl. des Jard.* ii. 56. — Darlington, *Fl. Cestr.* ed. 3, 281. — Chapman, *Fl.* 431. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 73. — Wesmael, *Bull. Féd. Soc. Hort. Belg.* 1861, 324, f. 3 (*Monogr. Pop.*); *De Candolle Prodr.* xvi. pt. ii. 326; *Mém. Soc. Sci. Hainaut,* sér. 3, iii. 233, t. 4 (*Monogr. Pop.*). — K. Koch, *Dendr.* ii. pt. i. 487. — Watson, *Am. Jour. Sci.* ser. 3, xv. 135. — Beal, *Am. Nat.* xv. 34, f. 2. — Lauche, *Deutsche Dendr.* ed. 2, 316. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 172. — Watson & Coulter, *Gray's Man.* ed. 6, 486. — Dippel, *Handb. Laubholzk.* ii. 195. — Koehne, *Deutsche Dendr.* 79.

Populus grandidentata, β pendula, Nuttall, *Gen.* ii. 239 (1818). — Torrey, *Compend. Fl. N. States,* 375. — Loudon, *Arb. Brit.* iii. 1651. — Wesmael, *De Candolle Prodr.* xvi. pt. 2, 326; *Mém. Soc. Sci. Hainaut,* sér. 3, iii. 234 (*Monogr. Pop.*).

A tree, often sixty or seventy feet in height, with a trunk occasionally two feet in diameter, and slender spreading rather rigid branches which form a narrow round-topped head; or generally smaller and usually not more than thirty or forty feet tall. The bark of the trunk near the base of old trees is from three quarters of an inch to an inch in thickness, dark brown tinged with red, irregularly fissured and divided into broad flat ridges roughened on the surface with small thick closely appressed scales; on younger stems and on the branches it is thinner, smooth, and light gray tinged with green. The branchlets are stout, marked with scattered oblong orange-colored lenticels, and coated at first, as are the unfolding leaves, the young petioles, and the stipules, with thick short hoary tomentum which soon disappears; during their first year they are dark red-brown or dark orange-color, and glabrous and lustrous, or covered with a delicate gray pubescence, and in their second year become dark gray sometimes slightly tinged with green and much roughened by the thickened elevated three-lobed leaf-scars. The buds spread from the branch at wide angles and are terete, broadly ovate, acute, with light bright chestnut-brown scales which, when the buds are first formed in summer, are coated with hoary pubescence or tomentum, and during the winter are puberulous, especially on their thin scarious margins; they are about an eighth of an inch long and not more than half the size of the flower-buds, which otherwise resemble them. The leaves are broadly ovate, three-ribbed, short-pointed, and coarsely and irregularly crenate with stout incurved callous teeth except at the broad abruptly wedge-shaped truncate or rounded base; they soon become glabrous, or occasionally on vigorous shoots they remain tomentose below during the season, and at maturity are thin and firm in texture, dark green on the upper surface, paler on the lower, from three to four inches long and from two to three inches broad, with prominent yellow ribs raised and rounded on the upper surface, conspicuous forked veins and reticulate veinlets; they are borne on slender laterally compressed petioles from one and a half to two and a half inches in length, and turn bright clear yellow in the autumn before falling. The stipules are linear, from one half to three quarters of an inch long, and caducous. The flower aments, which appear during the month of April or late in March, the staminate flowers usually opening

before the pistillate, are from one and a half to two and a half inches in length, with slender stems coated with pale hairs; their scales are pale and scarious below, divided above into from five to six small irregular acute lobes and covered with soft light gray hairs, which also clothe the disks of the flowers. The stamens vary from six to twelve in number, with short slender filaments and light red anthers, and are inserted on the shallow very oblique disk, which is entire on the margins. The ovary is oblong-conical, bright green, puberulous, crowned by a short style and spreading stigmas divided nearly to the base into elongated filiform lobes, and inclosed at the base in the deep, slightly oblique, crenate disk, persistent under the fruit. This ripens in May as the leaves are unfolding, when the pistillate aments are from four to five inches in length; the capsule is often more or less curved above the middle, light green and puberulous, thin-walled, two-valved, about an eighth of an inch long, and raised on a slender pubescent stalk. The seed is minute, dark brown, and surrounded by rather short snowy white hairs.

Populus grandidentata, which is a common inhabitant of the forest, usually selecting rich moist sandy soil near the borders of swamps and streams, is distributed from Nova Scotia through New Brunswick, southern Quebec and Ontario[1] to northern Minnesota,[2] southward through the northern states to northern Delaware[3] and southern Indiana and Illinois,[4] and along the Alleghany Mountains to North Carolina, and westward to central Kentucky and Tennessee.

The wood of *Populus grandidentata* is light, soft, and close-grained, but not strong; it contains thin obscure medullary rays and numerous minute scattered open ducts, and is light brown, with thin nearly white sapwood composed of from twenty to thirty layers of annual growth. The specific gravity of the absolutely dry wood is 0.4632, a cubic foot weighing 28.87 pounds. In northern New England and New York and in Canada it is largely manufactured into wood-pulp, and is occasionally used in turnery and for wooden-ware.

[1] Provancher, *Flore Canadienne*, ii. 533. — Brunet, *Cat. Vég. Lig. Can.* 55. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 56c. — Macoun, *Cat. Can. Pl.* 456.

[2] Macmillan, *Metaspermæ of the Minnesota Valley*, 180.

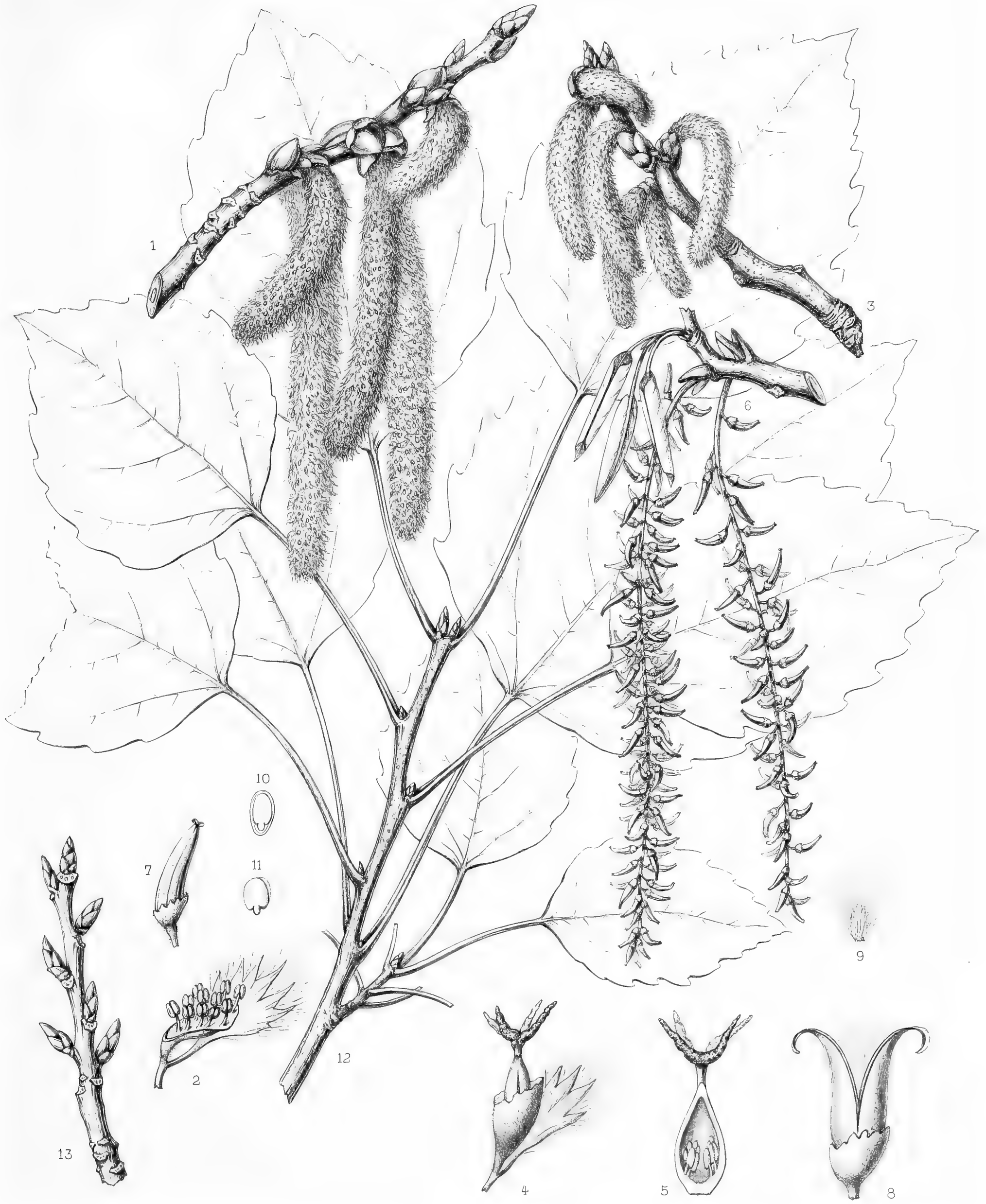
[3] Tatnall, *Cat. Pl. Newcastle Co., Delaware*, 70.

[4] Ridgway, *Proc. U. S. Nat. Mus.* v. 87 (*Populus tremuloides*), xvii. 414.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXXVIII. POPULUS GRANDIDENTATA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, enlarged.
5. Vertical section of a pistil, enlarged.
6. A fruiting branch, natural size.
7. A fruit, enlarged.
8. A fruit with open valves, enlarged.
9. A seed, magnified.
10. Vertical section of a seed, magnified.
11. An embryo, magnified.
12. A summer branch, natural size.
13. A winter branch, natural size.



C.E. Faxon del.

Rapine sc.

POPULUS GRANDIDENTATA, Michx.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

POPULUS HETEROPHYLLA.

Swamp Cottonwood. Black Cottonwood.

LEAVES broadly ovate, acute, short-pointed or rounded at the apex, crenately serrate; petioles terete.

Populus heterophylla, Linnæus, *Spec.* 1034 (1753). — Muenchhausen, *Hausv.* v. 232. — Marshall, *Arbust. Am.* 107. — Moench, *Bäume Weiss.* 81. — Wangenheim, *Nordam. Holz.* 85. — Walter, *Fl. Car.* 248. — Castiglioni, *Viag. negli Stati Uniti*, ii. 334. — Willdenow, *Berl. Baumz.* 233; *Spec.* iv. pt. ii. 806; *Enum.* 1017. — *Nouveau Duhamel*, ii. 181, t. 51. — Borkhausen, *Handb. Forstbot.* i. 547. — Michaux, *Fl. Bor.-Am.* ii. 244. — Desfontaines, *Hist. Arb.* ii. 466. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 401. — Pursh, *Fl. Am. Sept.* ii. 619. — Nuttall, *Gen.* ii. 239. — Hayne, *Dendr. Fl.* 203. — Elliott, *Sk.* ii. 712. — Sprengel, *Syst.* ii. 244. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 30 (*Revisio Populorum*); *Hist. Vég.* x. 386. — Torrey, *Fl. N. Y.* ii. 215. — Seringe, *Fl. des Jard.* ii. 61. — Darlington, *Fl. Cestr.* ed. 3, 281. — Chapman, *Fl.* 431. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 73. — Wesmael, *De Candolle Prodr.* xvi. pt. ii. 326; *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 232, t. 16 (*Monogr. Pop.*). — K. Koch, *Dendr.* ii. pt. i. 488. — Watson, *Am. Jour. Sci.* ser. 3, xv. 135. — Lauche, *Deutsche Dendr.* ed. 2, 316. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 172. — Britton, *Bull. Torrey Bot. Club*, xiv. 114. — Watson & Coulter, *Gray's Man.* ed. 6, 487. — Dippel, *Handb. Laubholzk.* ii. 193, f. 92. — Koehne, *Deutsche Dendr.* 80.

Populus balsamifera, Miller, *Dict.* ed. 8, No. 5 (not Linnæus) (1768).

Populus cordifolia, Burgsdorf, *Anleit. Anpfl.* pt. ii. 177 (1787).

Populus argentea, Michaux f. *Hist. Arb. Am.* iii. 290, t. 9 (1813).

Populus heterophylla, β argentea, Wesmael, *De Candolle Prodr.* xvi. pt. ii. 326 (1868); *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 233 (*Monogr. Pop.*).

A tree, eighty or ninety feet in height, with a tall trunk from two to three feet in diameter, and short rather slender branches which form a comparatively narrow round-topped head; or usually much smaller, especially in the Atlantic states, and at the north rarely more than forty feet tall. The bark of the trunk is from three quarters of an inch to an inch in thickness and light brown tinged with red; on old trunks it is broken into long narrow plates attached only at the middle and sometimes persistent for several years, and on young trunks it is divided by narrow shallow fissures into broad flat ridges separated on the surface into thick plate-like scales. The branchlets are stout and marked with small elongated pale lenticels, and contain a thick orange-colored pith; when they first appear they are coated with hoary caducous tomentum, and during their first year are dark red-brown and rather lustrous, or ashy gray, or rarely pale orange-color, and glabrous or slightly puberulous or covered with a glaucous bloom, and in their second year grow darker and become much roughened by the large thickened leaf-scars. The buds are slightly resinous, broadly ovate, acute, and covered with bright red-brown scales more or less coated toward the base with pale pubescence; the leaf-buds are nearly a quarter of an inch long and about half the size of the flower-buds. The leaves are broadly ovate, three-nerved, gradually narrowed and acute, short-pointed, or rounded at the apex, slightly cordate or truncate or rounded at the broad base, which is usually furnished with a narrow deep sinus, and finely or coarsely crenate with small incurved glandular teeth; when they unfold they are covered with thick hoary tomentum which soon disappears from the upper surface, and at maturity are thin and firm in texture, dark deep green above, pale and glabrous below, with the exception of the stout yellow midribs and forked veins which are sometimes tomentose, especially on vigorous shoots, rather conspicuously reticulate-venulose, from four to seven inches in length and from three to six inches in breadth; they are borne on slender terete tomentose or nearly glabrous petioles from two and a half to three and a half inches long, and in the autumn turn dull yellow or brown before falling. The stipules are linear-lanceolate, brown and scarious,

glabrous, from one half of an inch to an inch in length, and caducous. The flower aments appear from March at the south to the beginning of May at the north; the staminate are broad, densely flowered, about an inch long and erect when the flowers first open, but gradually become pendulous by the elongation of the thick peduncle, and when fully grown are from two to two and a half inches in length, with stout brittle puberulous stems; their scales are narrowly oblong-obovate, brown, scarious and glabrous below, divided above into numerous elongated filiform light red-brown lobes, and fugacious as the ament lengthens. The stamens vary from twelve to twenty in number, with slender filaments about as long as the large dark red anthers, and are inserted on an oblique slightly concave disk with a spreading border. The pistillate aments are slender, pendulous, few-flowered, and from one to two inches long, with thin glabrous stems; their scales, which are concave and infold the flowers, are linear-obovate, brown and scarious, laterally lobed, fimbriate above the middle, and caducous. The ovary is ovoid, terete or obtusely three-angled, with slightly concave sides, crowned by a short stout or elongated style, deciduous from the fruit, and two or three much thickened and dilated two or three-lobed stigmas, surrounded at the base by the thin and scarious deciduous disk which is irregularly divided into numerous triangular or linear acute teeth, and raised on an elongated slender stem. In maturing the fruiting aments become erect and from four to six inches long and the pedicels half an inch in length; the capsules ripen in May, when the leaves are about a third grown, and are ovate, acute, dark red-brown, rather thick-walled, two or three-valved, and about half an inch long. The seed is obovate, minute, dark red-brown, and surrounded by a thick mass of rather short lustrous silvery white hairs which are often more or less tinged with orange-color toward the base.

Populus heterophylla is distributed from North Guilford, Connecticut, and Northport, Long Island, southward near the coast to southern Georgia, through the Gulf States[1] to western Louisiana, and through Arkansas[2] to southeastern Missouri,[3] western Kentucky and Tennessee, and southern Illinois and Indiana.[4] In the north Atlantic states, where it is rare and local, the Black Cottonwood grows in low wet swamps; in the south Atlantic and Gulf regions it is more common, and grows on the borders of river-swamps which are often inundated; and in the valley of the lower Ohio River, in southeastern Missouri, eastern Arkansas, and western Mississippi, it is very abundant, growing to its largest size on the borders of swamps with the Texas Oak, the Swamp White Oak, the Red Maple, the Sweet Gum, and the Sour Gum.

The wood of *Populus heterophylla* is light, soft, and close-grained; it contains numerous very obscure medullary rays and small scattered open ducts, and is dull brown, with thin lighter brown sapwood composed of twelve or fifteen layers of annual growth. The specific gravity of the absolutely dry wood is 0.4089, a cubic foot weighing 25.48 pounds. It is now often manufactured into lumber in the valley of the Mississippi River and in the Gulf states, and under the name of black poplar is used in the interior finish of buildings.

Populus heterophylla was first described in the *Natural History of Carolina*,[5] published in 1731 by Mark Catesby, who discovered it in the coast region of South Carolina. According to Aiton,[6] it was cultivated in England by Dr. John Fothergill[7] as early as 1765, and it is now occasionally found in gardens in the United States and Europe.

[1] I have no evidence that *Populus heterophylla* grows in Florida, but as it is abundant in the alluvial swamps of the Mobile River and on the lower Tombigbee and Alabama Rivers in Alabama, it probably ranges eastward at least as far as the valley of the Appalachicola.

[2] Harvey, *Am. Jour. Forestry*, i. 456.

[3] Bush, *Rep. State Board Hort. Missouri*, 1895, 359.

[4] Ridgway, *Proc. U. S. Nat. Mus.* v. 86; *Bot. Gazette*, viii. 350.

[5] *Populus nigra folio maximo gemmis Balsamum odoratissimum fundentibus*, i. 34, t. 34. — Charlevoix, *Histoire de la Nouvelle France*, ed. 12mo, iv. 336, f. 48. — Romans, *Nat. Hist. Florida*, 26.

Populus magna foliis amplis, aliis cordiformibus, aliis subrotundis, junioribus tomentosis, Clayton, *Fl. Virgin.* 194.

Populus foliis cordatis crenatis, Linnæus, *Hort. Cliff.* 460. — Royen, *Fl. Leyd. Prodr.* 82.

Populus alba majoribus foliis subcordatis, Romans, *Nat. Hist. Florida*, 26.

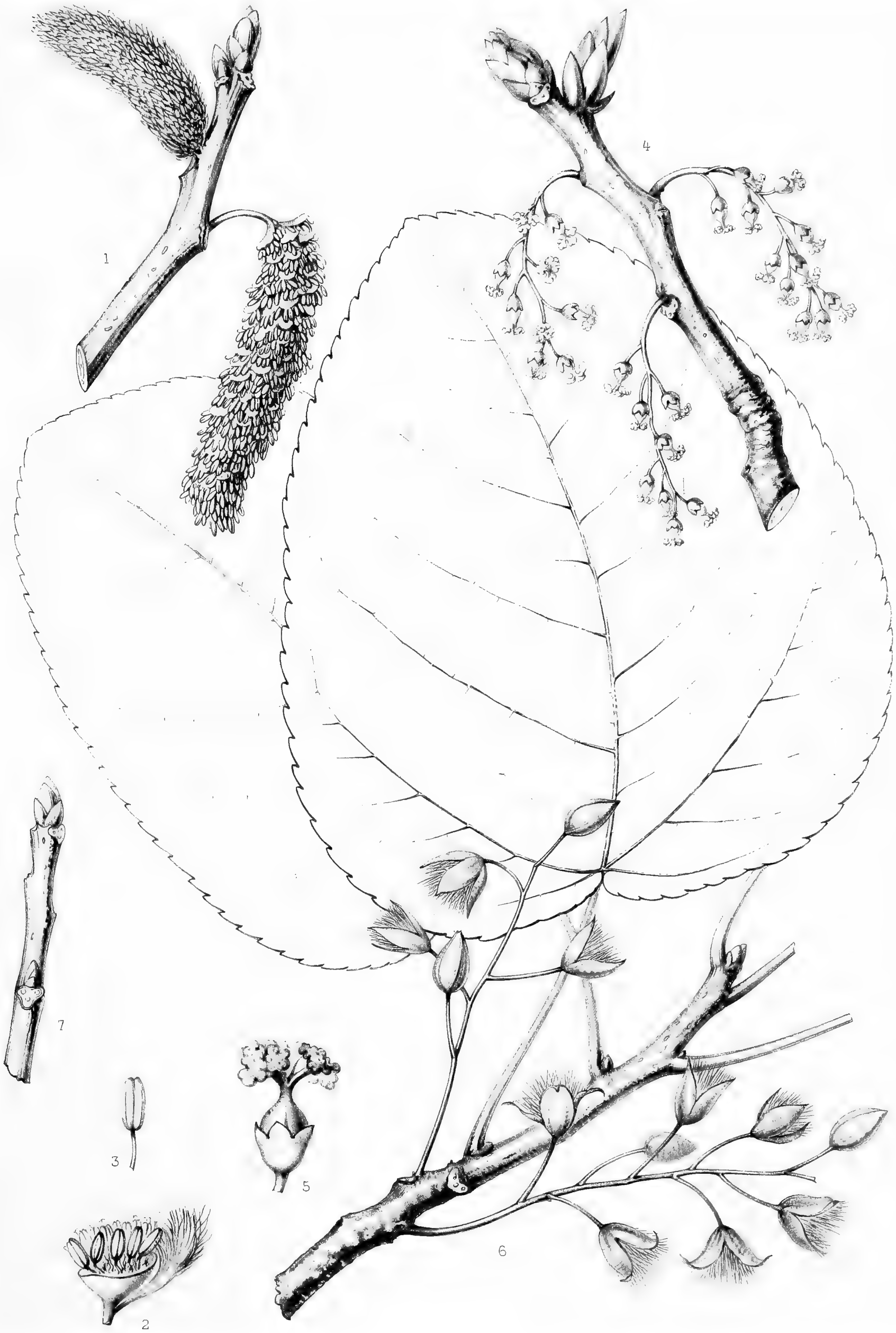
[6] *Hort. Kew.* iii. 407. — Loudon, *Arb. Brit.* iii. 1672, f. 1534.

[7] See vi. 16.

EXPLANATION OF THE PLATE.

PLATE CCCCLXXXIX. POPULUS HETEROPHYLLA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, enlarged.
3. A stamen, enlarged.
4. A flowering branch of the pistillate tree, natural size.
5. A pistillate flower, enlarged.
6. A fruiting branch, natural size.
7. A winter branch, natural size.



C. E. Faxon del. *Migneaux sc.*

POPULUS HETEROPHYLLA, L.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

POPULUS BALSAMIFERA.

Balsam. Tacamahac.

Leaves ovate-lanceolate, acute or acuminate, dark green and lustrous on the upper surface, pale and often ferrugineous on the lower.

Populus balsamifera, Linnæus, *Spec.* 1034 (excl. syn. Catesby & Gmelin) (1753). — Du Roi, *Harbk. Baumz.* ii. 143. — Marshall, *Arbust. Am.* 107. — Moench, *Bäume Weiss.* 79; *Meth.* 338. — Castiglioni, *Viag. negli Stati Uniti*, ii. 334 (excl. syn. Gmelin). — Schoepf, *Mat. Med. Amer.* 151. — Wangenheim, *Nordam. Holz.* 85, t. 28, f. 59. — Willdenow, *Berl. Baumz.* 230; *Spec.* iv. pt. ii. 805; *Enum.* 1017. — Borkhausen, *Handb. Forstbot.* i. 544. — *Nouveau Duhamel*, ii. 179, t. 50. — Michaux, *Fl. Bor.-Am.* ii. 244. — Persoon, *Syn.* ii. 624. — Desfontaines, *Hist. Arb.* ii. 466. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 401. — Michaux f. *Hist. Arb. Am.* iii. 306, t. 13, f. 1. — Pursh, *Fl. Am. Sept.* ii. 618. — Nuttall, *Gen.* ii. 239; *Sylva*, i. 55. — Hayne, *Dendr. Fl.* 202. — Sprengel, *Syst.* ii. 244. — Hooker, *Fl. Bor.-Am.* ii. 153 (in part and excl. var. γ). — Spach, *Ann. Sci. Nat.* sér. 2, xv. 33 (*Revisio Populorum*) (excl. syn. *suaveolens*); *Hist. Vég.* x. 393. — Fischer, *Gartenzeit.* ix. 402; *Bot. Reg.* xxix. Misc. 20. — Torrey, *Fl. N. Y.* ii. 216. — Seringe, *Fl. des Jard.* ii. 65. — Wesmael, *Bull. Féd. Soc. Hort. Belg.* 1861, 335, f. 14 (*Monogr. Pop.*) (excl. vars. β *intermedia* and γ *salicifolia*); *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 245, t. 8 (*Monogr. Pop.*) (excl. β *suaveolens*, γ *laurifolia*, and δ *viminalis*). — K. Koch, *Dendr.* ii. pt. i. 495. — Watson, *Am. Jour. Sci.* ser. 3, xv. 135. — Beal, *Am. Nat.* xv. 34, f. 4. — Lauche, *Deutsche Dendr.* ed. 2, 317 (in part). — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 173. — Mayr, *Wald. Nordam.* 181. — Watson & Coulter, *Gray's Man.* ed. 6, 487. — Dippel, *Handb. Laubholzk.* ii. 205 (excl. vars. a, b, c), f. 99. — Koehne, *Deutsche Dendr.* 83.

Populus balsamifera lanceolata, Marshall, *Arbust. Am.* 108 (1785).

Populus balsamifera, α **genuina**, Wesmael, *De Candolle Prodr.* xvi. pt. ii. 329 (1868).

A tree, often a hundred feet in height, with a tall trunk six or seven feet in diameter, and stout erect branches usually more or less contorted near their extremities, and forming a comparatively narrow open head; or smaller toward the southern limits of its range and usually not more than sixty or seventy feet tall. The bark on old trunks is from three quarters of an inch to an inch in thickness, gray tinged with red, and divided into broad rounded ridges covered with small closely appressed scales; on younger stems and on the branches it is much thinner, smooth or roughened by dark excrescences, and light brown tinged with green. The branchlets are stout, marked with oblong light orange-colored lenticels, and after their first year much roughened by the thickened leaf-scars; when they first appear they are dark red-brown and glabrous or covered with pale caducous pubescence, and in their first winter are bright and lustrous, losing their lustre and becoming dark orange-color in their second year, and then gray tinged with yellow-green. The leaf-buds, which are saturated with a yellow balsamic sticky exudation, are ovate, terete, and long-pointed, the terminal being nearly an inch long and one third of an inch broad, and the axillary about three quarters of an inch long and one sixteenth of an inch broad; they are covered with five oblong pointed concave closely imbricated thick scales dark chestnut-brown and lustrous on the outer surface and light green on the inner, and begin to open soon after midwinter. The leaves are ovate-lanceolate, three-ribbed, gradually narrowed and acute or acuminate at the apex, rounded or cordate at the broad or rarely narrowed base, and finely crenately serrate with slightly thickened revolute margins; when they unfold they are light yellow-green, coated with the gummy secretions of the bud and sometimes slightly puberulous, especially on the upper surface and on the petioles, and at maturity are thin and firm in texture, deep dark green and lustrous above, pale green and more or less ferrugineous and conspicuously reticulate-venulose below, from three to five inches long and from an inch and a half to three inches wide, with slender ribs raised and

rounded on the upper side, thin veins running obliquely almost to the margins, and slender terete petioles from an inch and a half to two inches in length, enlarged abruptly near the base and leaving when they fall large semiorbicular obcordate leaf-scars. The stipules of the first leaves resemble the bud-scales in size and shape and are caducous; higher on the branch they gradually decrease in size and thickness, and on the upper leaves they are oblong-lanceolate, thin, white and scarious, slightly ciliate on the margins, and about a third of an inch long, and often do not disappear until the leaves are almost fully grown. The flower-buds resemble the terminal leaf-buds in size and shape, and are covered by five or six deciduous scales similar to those of the leaf-buds. The aments appear in very early spring before the leaves, and are pedunculate, thin-stemmed, pendulous, densely flowered, from two and a half to four inches long and about a third of an inch thick; their scales are broadly obovate, light brown and scarious, and often irregularly three-lobed or parted at the apex, which is cut into short thread-like red-brown lobes. The stamens vary from twenty to thirty in number, with abbreviated filaments and large light red anthers, and are inserted on an oblique slightly concave short-stalked disk. The ovary is ovate, slightly two-lobed, and sessile in the deep cup-shaped disk, which has a thick and undulate margin, and is crowned by two nearly sessile large oblique dilated crenulate stigmas deciduous from the fruit. The fruiting aments become four or five inches in length when the capsules open at the end of May or early in June; these are ovate-oblong, acute and often curved at the apex, two-valved, slightly pitted, light brown, about a quarter of an inch long, thin-walled, surrounded at the base by the membranaceous disks of the flower, and raised on slender stalks from one twelfth to one eighth of an inch in length. The seeds are oblong-obovate, pointed at the apex, narrowed and truncate at the base, light brown, about one twelfth of an inch long, and surrounded by slender hairs which envelop the aments of the ripe fruits with thick masses of soft snow-white cotton, and becoming detached from the capsules are wafted with the seeds to great distances from the tree.

Populus balsamifera is distributed from about latitude sixty-five north in the valley of the Mackenzie River, and from the Alaskan coast southward to northern New England and New York,[1] central Michigan and Minnesota,[2] the Black Hills of Dakota,[3] northwestern Nebraska,[4] northern Montana, Idaho, and Oregon and Nevada. It inhabits the low and often inundated bottom-lands of rivers and swamp borders, and is common in all the regions near the northern boundary of the United States from Maine to the western limits of the Atlantic forest, in the maritime provinces of Canada, and in southern Labrador as far north as the shore of Richmond's Gulf on Hudson's Bay; it is abundant, although not large, along all the streams which flow into James's Bay, and into Hudson's Bay from the southwest as far north as Fort Churchill; it is common and of large size in the region north of the Great Lakes,[5] and it is the characteristic tree of the alluvial bottom-lands of the streams which flow through the prairie region of British America, attaining its greatest size on the islands and banks of the Pease, Athabasca, and other rivers which form the Mackenzie, which carries down great trunks of the Balsam Poplar, undermined by the shifting currents of the turbulent streams of the north, to bleach upon the shores of the Arctic Sea;[6] it is also abundant in the valley of the upper Yukon;[7] and on these northern bottom-lands is replaced by the Spruce as the subsoil becomes cold by the dense shade made by the Poplars and Willows which first cover the surfaces exposed by the washing away of banks and the formation of islands; in the United States west of the Red River of the North it is less common and of smaller size.

[1] Professor William R. Dudley found in 1885 on the steep woody banks of the ravine at Taughannock Falls, near the west side of Cayuga Lake, in western New York, a number of old trees of this species which may have grown there without the intervention of man, although this is much farther south than *Populus balsamifera* usually extends in New York state (*Bull. Cornell University*, ii. 92 [*Cayuga Fl.*]).

[2] Macmillan, *Metaspermæ of the Minnesota Valley*, 180.

[3] Williams, *Bull.* No. 43, *South Dakota Agric. Coll.* 104.

[4] Bessey, *Rep. Nebraska State Board Agric.* 1894, 104.

[5] Provancher, *Flore Canadienne*, ii. 533. — Brunet, *Cat. Vég. Lig. Can.* 55. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 45°. — Macoun, *Cat. Can. Pl.* 456; *Trans. Roy. Soc. Can.* iv. 7.

[6] Richardson, *Franklin Jour.* Appx. No. 7, 766.

[7] G. M. Dawson, *Garden and Forest*, i. 58.

The wood of *Populus balsamifera* is light, soft, not strong, and close-grained; it contains numerous obscure medullary rays and many minute scattered open ducts, and is light brown, with thick nearly white sapwood. The specific gravity of the absolutely dry wood is 0.3635, a cubic foot weighing 22.65 pounds. It is made into paper-pulp, and in northern Michigan is manufactured into pails, tobacco boxes, and small packing-cases. On the northern shores of the Great Lakes the thick bark from the base of old trunks is used as a substitute for cork to float fishermen's nets.

In the northeastern United States and in Canada the Balm of Gilead, *Populus balsamifera*, var. *candicans*,[1] is frequently cultivated as a shade-tree. It differs from the common form in its more spreading branches, forming a broader and more open head, in its broader cordate leaves which are more coarsely serrate with gland-tipped teeth, more or less pubescent when young and at maturity paler on the lower surface, ciliate on the margins with short white hairs, and usually pubescent along the ribs and principal veins, and in its pubescent petioles and rather heavier wood.

The Balsam Poplar, which is the largest of the subarctic trees of America, is the most conspicuous feature of vegetation over areas thousands of square miles in extent, and its great size, its stately trunk, and the brilliancy of its leaves, displaying in turn, as the wind plays among its branches, their dark green upper and their rusty lower surfaces, often make it a splendid object.

According to Aiton, *Populus balsamifera* was introduced into English gardens in 1731.[2]

[1] *Populus balsamifera*, var. *candicans*, Gray, *Man.* ed. 2, 419 (1856). — Watson, *Am. Jour. Sci.* sér. 3, xv. 135. — *Bull. Torrey Bot. Club*, vii. 57. — Lauche, *Deutsche Dendr.* ed. 2, 318. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 173. — Watson & Coulter, *Gray's Man.* ed. 6, 487.

Populus candicans, Aiton, *Hort. Kew.* iii. 406 (1789). — Willdenow, *Berl. Baumz.* 231; *Spec.* iv. pt. ii. 806; *Enum.* 1017. — Borkhausen, *Handb. Forstbot.* i. 545. — Michaux f. *Hist. Arb. Am.* iii. 308, t. 13, f. 2. — Pursh, *Fl. Am. Sept.* ii. 618. — Poiret, *Lam. Dict.* Suppl. iv. 378. — Nuttall, *Gen.* ii. 239. — Hayne, *Dendr. Fl.* 202. — Bigelow, *Fl. Boston.* ed. 2, 370. — Sprengel, *Syst.* ii. 244. — Hooker, *Fl. Bor.-Am.* ii. 154. — Fischer, *Gartenzeit.* ix. 403; *Bot. Reg.* xix. Misc. 22. — Torrey, *Fl. N. Y.* ii. 217. — Audubon, *Birds*, t. 59. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 33 (*Revisio Populorum*); *Hist. Vég.* x. 392. — Emerson, *Trees Mass.* 245; ed. 2, i. 281. — Seringe, *Fl. des Jard.* ii. 63. — Gray, *Man.* 431. — Wesmael, *Bull. Féd. Soc. Hort. Belg.* 1861, 334, f. 12 (*Monogr. Pop.*); *De Candolle Prodr.* xvi. pt. ii. 330; *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 248, t. 9 (*Monogr. Pop.*). — Dippel, *Handb. Laubholzk.* ii. 203 (excl. var. a). — Koehne, *Deutsche Dendr.* 83.

The origin of this noble and beautiful tree is uncertain. It does not appear to be indigenous in New England or eastern Canada, where the pistillate plant has been used as a shade-tree from very early times, as it has been in the middle states and in Europe. It is stated by Professor L. H. Bailey (*Bot. Gazette*, v. 91; *Bull.* No. 68, *Cornell University, Hort. Div.* 221 [*The Cultivated Poplars*]) to be indigenous in Michigan, where it is said that groves of it existed when the country was first settled, and were afterward cut down for lumber. I have not seen it except in the neighborhood of human habitations or in specimens taken from trees which had evidently been cultivated. The width of the leaves, their ciliate margins, and pubescence are the only characters for distinguishing it from the ordinary forms of *Populus balsamifera*, and they hardly afford sufficient grounds for considering it, as many authors have done, specifically distinct, at least until more knowledge with regard to it as a wild tree is obtained.

[2] *Hort. Kew.* iii. 446. — Loudon, *Arb. Brit.* iii. 1637, f. 1535, 1536, t.

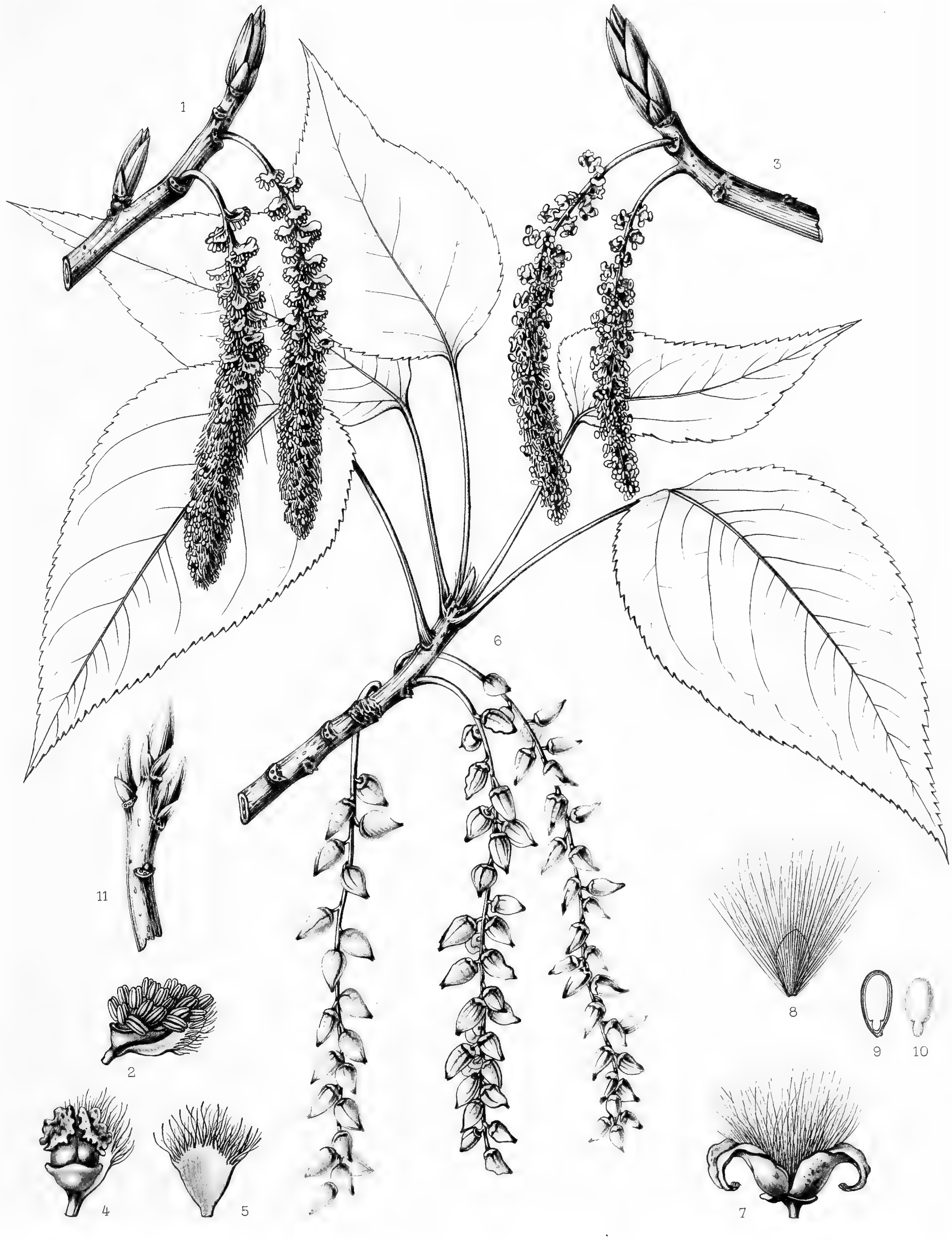
EXPLANATION OF THE PLATES.

Plate CCCCXC. Populus balsamifera.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, enlarged.
5. A scale of a pistillate flower, enlarged.
6. A fruiting branch, natural size.
7. A fruit with open valves, enlarged.
8. A seed, magnified.
9. Vertical section of a seed, magnified.
10. An embryo, much magnified.

Plate CCCCXCI. Populus balsamifera, var. candicans.

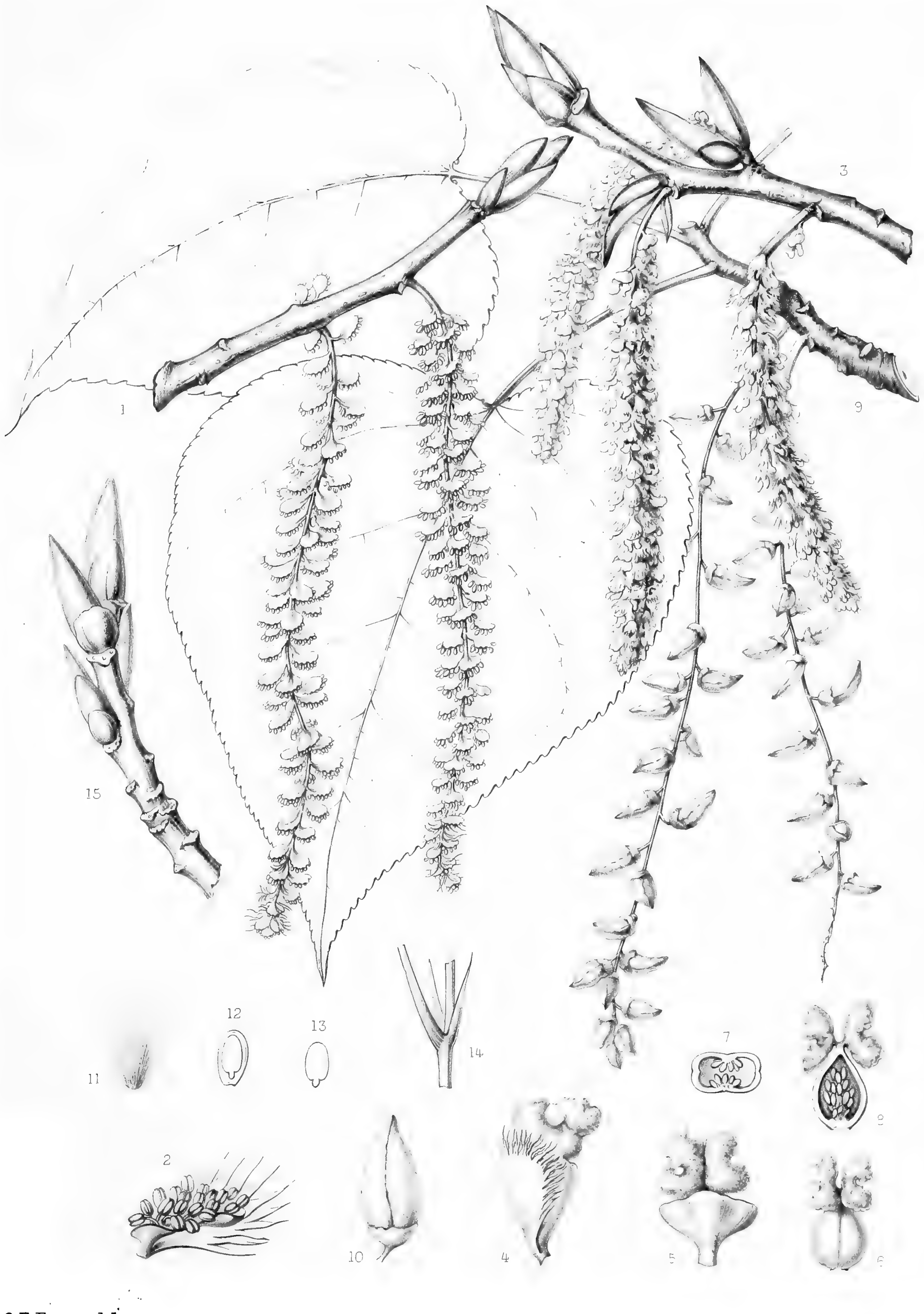
1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower infolded in its scale, enlarged.
5. A pistillate flower, enlarged.
6. A pistil, enlarged.
7. Cross section of an ovary, enlarged.
8. Vertical section of an ovary, enlarged.
9. A fruiting branch, natural size.
10. A fruit, enlarged.
11. A seed, magnified.
12. Vertical section of a seed, magnified.
13. An embryo, magnified.
14. Portion of a branch with the base of a petiole, and stipules, enlarged.
15. A winter branch, natural size.



C.E.Faxon del. *Toulet sc.*

POPULUS BALSAMIFERA, L.

A.Riocreux direx.t *Imp.J.Taneur, Paris.*



C.E. Faxon del.

Migneaux sc.

POPULUS BALSAMIFERA, Var. CANDICANS, Gray.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

POPULUS ANGUSTIFOLIA.

Narrow Leaved Cottonwood.

LEAVES lanceolate or ovate-lanceolate, green on both surfaces.

Populus angustifolia, James, *Long's Exped.* i. 497 (1823). — Torrey, *Ann. Lyc. N. Y.* ii. 249; *Frémont's Rep.* 97; *Sitgreaves' Rep.* 172; *Ives' Rep.* 27. — Nuttall, *Sylva*, i. 52, t. 16. — Watson, *Am. Jour. Sci.* ser. 3, xv. 135. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 174. — Coulter, *Man. Rocky Mt. Bot.* 339. — Dippel, *Handb. Laubholzk.* ii. 202, f. 97. — Koehne, *Deutsche Dendr.* 83. — Rydberg, *Bull. Torrey Bot. Club*, xx. 50, t. 140.

Populus salicifolia, Rafinesque, *Alsograph. Am.* 43 (1838).

Populus Canadensis, γ **angustifolia**, Wesmael, *De Candolle Prodr.* xvi. pt. ii. 329 (1868); *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 243 (*Monogr. Pop.*).

Populus balsamifera, var. **angustifolia**, Watson, *King's Rep.* v. 327 (1871); *Pl. Wheeler*, 17. — Porter, *Hayden's Rep.* 1871, 494. — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* No. 4, 129.

A tree, fifty or sixty feet in height, with a trunk rarely more than eighteen inches in diameter, and slender erect branches which form a narrow and usually pyramidal head. The bark of the trunk is from three quarters of an inch to an inch in thickness, light yellow-green, divided near the base of old trees by shallow fissures into broad flat ridges, and smooth and much thinner on the upper part of the trunk, on young stems, and on the branches. The branchlets are slender and marked with pale lenticels, glabrous or rarely puberulous and light yellow-green when they first appear, rather bright or, on vigorous young shoots, often dark orange-color during their first winter, and pale yellow in their second, becoming ashy gray in their third or fourth year. The buds are saturated with fragrant balsamic exudations, and are ovate, long-pointed, and covered by about five thin concave scales, chestnut-brown on the outer surface and yellow-green on the inner; the terminal bud is terete, from one fourth to one half of an inch long, and nearly twice as large as the axillary buds, which are often much flattened posteriorly by pressure against the stem. The leaves are lanceolate, ovate-lanceolate, or rarely obovate, narrowed to the tapering acute or rounded apex, gradually narrowed and wedge-shaped or rounded at the base, and finely or, on vigorous shoots, more coarsely serrate with incurved teeth furnished at first with small dark glands which often disappear before the end of the season; when they unfold they are slightly puberulous on the lower surface, and at maturity are thin and firm, glabrous or rarely puberulous below, bright yellow-green on the upper surface and rather paler on the lower, from two to three inches long and from half an inch to an inch wide or, on vigorous shoots, occasionally six or seven inches long and an inch and a half wide, with stout yellow midribs and numerous slender oblique primary veins arcuate and often united near the slightly thickened revolute margins, and obscure reticulate veinlets; they are borne on slender petioles somewhat flattened on the upper side toward the slightly enlarged base, and turn dull yellow in the autumn before falling, when they leave small nearly oval or obcordate scars. The stipules of the first leaves resemble the bud-scales in size and shape; higher on the branch they gradually decrease in size, and on the last leaves are ovate or linear-lanceolate, white and scarious, and from half an inch to nearly an inch in length, and usually fall before the leaf has grown to its full size. The aments are densely flowered, glabrous, short-stalked, pendulous, and from one and a half to two and a half inches long, and appear before the leaves; their scales are glabrous, thin and scarious, light brown, broadly obovate, and deeply and irregularly cut into numerous dark red-brown filiform lobes. The stamens, which vary from twelve to twenty in number and consist of short filaments and large light red anthers, are inserted in a deep cup-shaped short-stalked slightly oblique disk with thickened reflexed margins. The ovary is ovate, more or less two-lobed, crowned

by a short or elongated style and two oblique dilated irregularly lobed stigmas deciduous from the fruit, and inclosed at the base in a shallow cup-shaped disk slightly and irregularly lobed on the margins and raised on a short pedicel. The pistillate ament lengthens as the capsules enlarge, and when they open in May or early in June it is from two and a half to four inches in length, with pedicels often a third of an inch long; the capsule is broadly ovate, often rather abruptly contracted above the middle, short-pointed, rugose, thin-walled, two-valved, and surrounded at the base by the membranaceous disk of the flower. The seeds are ovate or obovate, rather acute, light brown, nearly an eighth of an inch long, and surrounded by long soft lustrous white hairs.

Populus angustifolia inhabits the banks of streams usually at elevations of from five to ten thousand feet above the level of the sea, and is distributed from the valley of the Milk, Belly, and other streams in southwestern Assiniboia,[1] the Black Hills of Dakota[2] and northwestern Nebraska,[3] southward through the mountain regions of the interior of the continent, to the ranges of central Nevada, the Mogollon Mountains of New Mexico,[4] and the ranges of central Arizona,[5] and is the common Poplar of northern Colorado, Utah, Wyoming, southern Montana, and eastern Idaho.[6]

The wood of *Populus angustifolia* is light, soft, and weak; it contains numerous obscure medullary rays and minute scattered open ducts, and is light brown, with thin nearly white sapwood composed of from ten to thirty layers of annual growth. The specific gravity of the absolutely dry wood is 0.3912, a cubic foot weighing 24.38 pounds.

The earliest description of the Narrow-leaved Cottonwood appears in the narrative of the expedition which crossed the continent under command of Captains Lewis and Clark in 1804–1806,[7] but the name was not published until several years later, when it was found in Colorado by Dr. Edwin James,[8] the surgeon and naturalist of the party sent by the government of the United States, under command of Major Long, to explore the southern Rocky Mountains.

Populus angustifolia, which in habit and in the shape and color of its leaves resembles some of the broad-leaved Willows, is very generally planted as a shade-tree in the streets of the towns of Colorado and Utah, where it grows rapidly when well supplied with water, and soon forms a shapely conical head. It is occasionally cultivated in the gardens of the United States and Europe, and has proved hardy in eastern Massachusetts, where it is established in the Arnold Arboretum.

[1] Macoun, *Cat. Can. Pl.* 457.

[2] Williams, *Bull.* No. 43, *South Dakota Agric. Coll.* 104.

[3] Bessey, *Rep. Nebraska State Board Agric.* 1894, 104.

[4] Rusby, *Bull. Torrey Bot. Club*, ix. 106.

[5] The specimen (No. 2990) without flowers or fruit of a Poplar collected by Mr. S. B. Parish in June, 1894, in Rattlesnake Cañon, at an elevation of 5,500 feet at the eastern base of the San Bernardino Mountains in California, preserved in the National Herbarium, is probably of this species, although I have no other evidence that it crosses the California deserts (S. B. Parish, *Erythea*, iii. 60).

[6] A Poplar (*Populus acuminata*, Rydberg, *Bull. Torrey Bot. Club*, xx. 46, t. 149 [1893]) with rhomboidal leaves rather coarsely serrate at the middle only and long petioles, described as a large tree with a broad pyramidal crown of spreading branches, is distributed from the Black Hills of South Dakota and western Nebraska to the eastern base of the Rocky Mountains in Colorado, and apparently also occurs in Mexico; although often confounded with *Populus angustifolia*, it is probably a distinct species, and will be included in a supplement to *The Silva* if sufficient material can be obtained from which to prepare a plate and description.

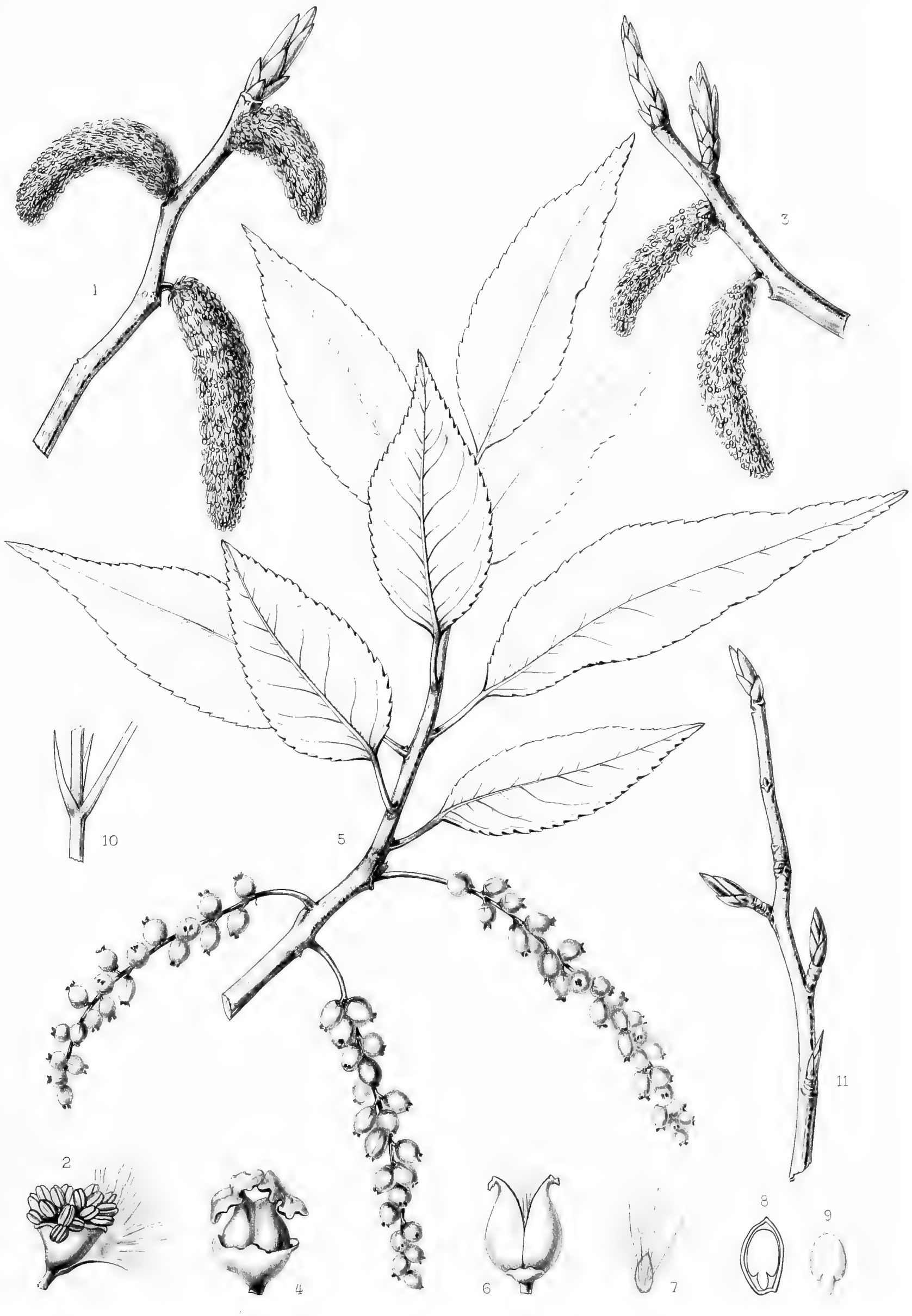
[7] On June 6, 1805, the party was on the Tansy (now Teton) River, a tributary of the upper Missouri, where they found "a species of Cottonwood, with a leaf like that of the Wild Cherry," and on the 12th of June they noticed that "with the broad-leaved Cottonwood, which has formed the principal timber of the Missouri, is here mixed another species, differing from the first only in the narrowness of its leaf and the greater thickness of its bark. This species seems to be preferred by the beavers to the broad-leaved, probably because the former affords a deeper and softer bark." (See *A History of the Expedition under Command of Lewis and Clark*, ed. Coues, ii. 356, 364.)

[8] See ii. 96.

EXPLANATION OF THE PLATE.

Plate CCCCXCII. Populus angustifolia.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A staminate flower with its scale, enlarged.
5. A fruiting branch, natural size.
6. A fruit with open valves, enlarged.
7. A seed, magnified.
8. Vertical section of a seed, magnified.
9. An embryo, magnified.
10. Portion of a branch with a petiole, and stipules, enlarged.
11. A winter branch, natural size.



C.E. Faxon del. *Himely sc.*

POPULUS ANGUSTIFOLIA, James.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

POPULUS TRICHOCARPA.

Black Cottonwood. Balsam Cottonwood.

LEAVES usually broadly ovate, acuminate, rounded or cordate at the broad base, dark green on the upper surface, pale, ferrugineous or silvery on the lower. Ovaries tomentose.

Populus trichocarpa, Hooker, *Icon.* ix. t. 878 (1852). — Walpers, *Ann.* v. 767. — Wesmael, *De Candolle Prodr.* xvi. pt. ii. 330; *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 249 (*Monogr. Pop.*). — Watson, *King's Rep.* v. 328; *Am. Jour. Sci.* ser. 3, xv. 136. — Torrey, *Bot. Wilkes Explor. Exped.* 469. — Brewer & Watson, *Bot. Cal.* ii. 91. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 174. — Dippel, *Handb. Laubholzk.* ii. 210, f. 104. — Koehne, *Deutsche Dendr.* 85. — Coville, *Contrib. U. S. Nat. Herb.* iv. 200 (*Bot. Death Valley Exped.*). — Greene, *Man. Bot. Bay Region*, 300.

Populus balsamifera, γ, Hooker, *Fl. Bor.-Am.* ii. 154 (1839).

Populus angustifolia, Newberry, *Pacific R. R. Rep.* vi. pt. iii. 89 (not James) (1857). — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 29, 68. — Torrey, *Bot. Wilkes Explor. Exped.* 468.

Populus balsamifera, Lyall, *Jour. Linn. Soc.* vii. 134 (not Linnæus) (1864). — Hall, *Bot. Gazette*, ii. 93.

Populus balsamifera, var. (?) **Californica**, Watson, *Am. Jour. Sci.* ser. 3, xv. 135 (1878).

Populus trichocarpa, var. **cupulata**, Watson, *Am. Jour. Sci.* ser. 3, xv. 136 (1878). — Brewer & Watson, *Bot. Cal.* ii. 91.

A tree, often nearly two hundred feet in height, with a trunk seven or eight feet in diameter, stout upright branches, and a broad open head; or toward the eastern and southern limits of its range much smaller. The bark of the trunk is from one and a half to two and a half inches in thickness, ashy gray, and deeply divided into broad rounded ridges broken on the surface into thick closely appressed scales. The branchlets are stout, terete or slightly angled while young, and marked with numerous orange-colored lenticels, and when they first appear are coated with deciduous rufous or pale pubescence; they are light or dark orange-color and lustrous during their first year, and then gradually grow dark gray and become much roughened by the greatly enlarged and thickened elevated lunate leaf-scars. The winter-buds are resinous and fragrant, ovate, long-pointed, frequently curved above the middle, and often flattened by pressure against the stem; they are about three quarters of an inch long and a quarter of an inch broad, and are covered by six or seven light orange-brown scales thin and scarious on the margins and slightly puberulous on the outer surface, especially at the base of the bud. The leaves are broadly ovate or occasionally oblong-rhombic, gradually narrowed and usually short-pointed or rarely acute at the apex, broad, rounded, or slightly cordate, or occasionally gradually narrowed and wedge-shaped at the base, and finely crenately serrate with minute incurved gland-tipped teeth; when they unfold they are coated with rufous or pale pubescence which is thicker above than below, and at maturity are thick and firm in texture, dark rich green and lustrous on the upper surface, pale and rusty or silvery white and conspicuously reticulate-venulose on the lower surface, glabrous, with the exception of the upper side of the stout ribs and veins, which is usually covered with a fine short pubescence that occasionally extends also over the whole upper surface of the leaf, from three to four inches long and from an inch and a half to three inches broad; they are borne on slender terete puberulous petioles from one to two inches in length, and turn yellow or brown late in the autumn before falling. The stipules of the first leaves resemble the inner bud-scales in size and shape, but higher on the branch they gradually become smaller, and those of the last leaves are linear-lanceolate, white and scarious, and about half an inch long. The flower aments, which appear in February at the south and in early spring at the north, are pedunculate and pendulous; the staminate are densely flowered, from an inch

and a half to two inches long and a third of an inch thick, with slender glabrous stems, and the pistillate are loosely flowered and from two and a half to three inches in length, with stout hoary tomentose stems; their scales are dilated at the apex, which is irregularly cut into numerous filiform lobes, and glabrous or slightly puberulous on the outer surface, and fall before the ripening of the fruit. The stamens, from forty to sixty in number, are inserted on a broad slightly oblique glabrous disk, and are composed of slender elongated filaments longer than the large light purple anthers. The ovary is subglobose, coated with thick hoary tomentum, crowned by three nearly sessile broadly dilated deeply lobed stigmas, and inclosed at the base in a thick deep cup-shaped glabrous membranaceous disk with an irregularly crenate or nearly entire revolute margin persistent under the fruit. When the capsule ripens the leaves are almost fully grown and the pistillate aments are from four to five inches in length; the capsule is subglobose, nearly sessile, pubescent or rarely almost glabrous, rather thick-walled, and three-valved. The seed is obovate, apiculate at the gradually narrowed apex, light brown, puberulous toward both ends, one twelfth of an inch long, and furnished with a tuft of long lustrous white hairs.

Populus trichocarpa forms open groves by the banks of streams, and is distributed from southern Alaska[1] southward through western British Columbia, where it extends eastward to the valley of the Columbia River,[2] through western Washington and Oregon, and along the mountain ranges and islands[3] of western California to the southern slope of the San Bernardino Mountains.[4] In the valley of the lower Stikeen River and southward through all the coast region to northern California, it grows to its largest size not far above the level of the sea; farther south and beyond the influence of the ocean it is smaller, often not more than thirty or forty feet tall, and ascends into mountain cañons, frequently reaching elevations of six thousand feet on the western slopes of the Sierra Nevada of central California; in western British Columbia, Washington, and Oregon it abounds in all the river-valleys and is the largest of the broad-leaved trees.

The wood of *Populus trichocarpa* is light, soft, and not strong, although rather close-grained; it contains thin hardly distinguishable medullary rays and minute open scattered ducts, and is light dull brown, with thin nearly white sapwood. The specific gravity of the absolutely dry wood is 0.3814, a cubic foot weighing 23.77 pounds. In Oregon and Washington, where the demand for the wood has already caused the destruction of most of the old trees, it has been largely made into the staves of sugar-barrels; and it is also used in the manufacture of wooden-ware, bowls, and butter-tubs, although its bitter taste lessens its value for these purposes, and by the Indians of British Columbia in the building of canoes.[5]

The soft pliable tough roots were formerly used by the Indians of Oregon and northern California in the manufacture of hats and baskets.[6]

The earliest account of *Populus trichocarpa* appears in the journal of Lewis and Clark for March 26, 1806, where the Cottonwoods growing near the mouth of the Columbia River are mentioned.[7]

The tallest and one of the largest of all Poplars, *Populus trichocarpa*, is conspicuous throughout the fluvial regions of the northwest coast, while it enlivens the coniferous forest of the California Sierra Nevada with the brilliancy of its pale stems and the fluttering of its beautiful lustrous leaves.[8]

[1] The extreme northern range of *Populus trichocarpa* is still undetermined. In 1887 Dr. G. M. Dawson, while exploring the region between 56° 30′ and 60° north latitude and 128° and 138° west longitude, found it on the lower Stikeen River, and in the drier region east of the coast ranges, associated with *Populus balsamifera* of the east, and a Poplar, probably of the same species, on the Pelly and Lewis branches of the Yukon River. (See G. M. Dawson, *Garden and Forest*, i. 58.)

[2] Macoun, *Cat. Can. Pl.* 457.

[3] Greene, *Bull. Cal. Acad. Sci.* ii. 412. — Brandegee, *Proc. Cal. Acad. Sci.* ser. 2, i. 216 (*Fl. Santa Barbara Islands*).

[4] S. B. Parish, *Zoë*, iv. 348.

[5] G. M. Dawson, *Can. Nat.* n. ser. ix. 331.

[6] Havard, *Garden and Forest*, iii. 620.

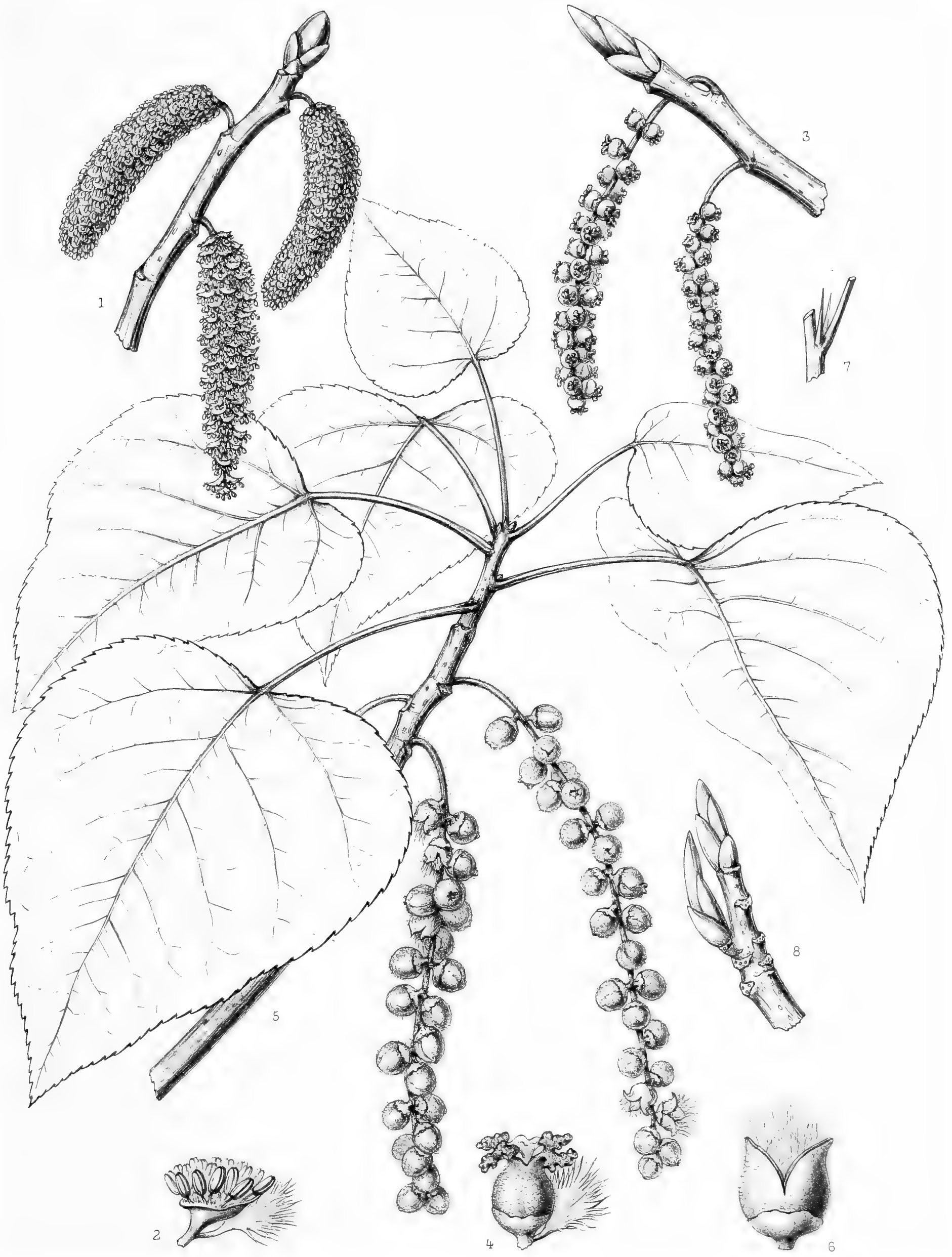
[7] *A History of the Expedition under Command of Lewis and Clark*, ed. Coues, iii. 908.

[8] *Garden and Forest*, v. 277, f. 52.

EXPLANATION OF THE PLATE.

PLATE CCCCXCIII. POPULUS TRICHOCARPA.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, enlarged.
5. A fruiting branch, natural size.
6. A fruit with open valves, enlarged.
7. Portion of a branch with a petiole, and stipules, enlarged.
8. A winter branch, natural size.



C.E.Faxon del. *Rapine sc.*

POPULUS TRICHOCARPA, Hook.

A.Riocreux direx.t *Imp. J.Taneur, Paris.*

POPULUS DELTOIDEA.

Cottonwood.

LEAVES deltoid or broadly ovate, usually abruptly acuminate, coarsely crenate; petioles laterally compressed.

Populus deltoidea, Marshall, *Arbust. Am.* 106 (1785). — Sudworth, *Bull. Torrey Bot. Club*, xx. 43.

Populus heterophylla, Du Roi, *Harbk. Baumz.* ii. 150 (not Linnæus) (1772).

Populus nigra, Marshall, *Arbust. Am.* 107 (not Linnæus) (1785).

Populus Carolinensis, Moench, *Bäume Weiss.* 81 (1785). — Burgsdorf, *Anleit. Anpfl.* pt. ii. 176. — Borkhausen, *Handb. Forstbot.* i. 550.

Populus Canadensis, Moench, *Bäume Weiss.* 81 (1785). — Burgsdorf, *Anleit. Anpfl.* pt. ii. 177. — Castiglioni, *Viag. negli Stati Uniti*, ii. 334. — Borkhausen, *Handb. Forstbot.* i. 552. — Michaux f. *Hist. Arb. Am.* iii. 298, t. 11. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 32 (*Revisio Populorum*); *Hist. Vég.* x. 390. — Seringe, *Fl. des Jard.* ii. 65. — Fiscali, *Deutsch. Forstculturpfl.* 128, t. 8, f. 10–14. — Wesmael, *Bull. Féd. Soc. Hort. Belg.* 1861, 330, f. 8 (*Monogr. Pop.*); *De Candolle Prodr.* xvi. pt. ii. 329 (excl. γ *angustifolia*); *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 242 (*Monogr. Pop.*) (excl. γ *angustifolia*). — K. Koch, *Dendr.* ii. pt. i. 491. — Beal, *Am. Nat.* xv. 34, f. 3. — Lauche, *Deutsche Dendr.* ed. 2, 317. — Dippel, *Handb. Laubholzk.* ii. 199. — Koehne, *Deutsche Dendr.* 81.

Populus Virginiana, Fougeroux, *Mém. Agric. Paris*, 87 (1786). — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 400. — *Nouveau Duhamel*, ii. 186.

Populus lævigata, Aiton, *Hort. Kew.* iii. 406 (1789). — Willdenow, *Spec.* iv. pt. ii. 803. — Pursh, *Fl. Am. Sept.* ii. 619. — Poiret, *Lam. Dict.* Suppl. iv. 378. — Nuttall, *Gen.* ii. 239; *Sylva*, i. 54. — Sprengel, *Syst.* ii. 244. — Emerson, *Trees Mass.* 246; ed. 2, i. 283.

Populus angulata, Aiton, *Hort. Kew.* iii. 407 (1789). — Willdenow, *Berl. Baumz.* 234; *Spec.* iv. pt. ii. 805; *Enum.* 1017. — Borkhausen, *Handb. Forstbot.* i. 548. — *Nouveau Duhamel*, ii. 186. — Desfontaines, *Hist. Arb.* ii. 466. — Michaux f. *Hist. Arb. Am.* iii. 302, t. 12. — Pursh, *Fl. Am. Sept.* ii. 619. — Rafinesque, *Fl. Ludovic.* 116. — Nuttall, *Gen.* ii. 239. — Torrey, *Ann. Lyc. N. Y.* ii. 249. — Elliott, *Sk.* ii. 711. — Sprengel, *Syst.* ii. 244. — Jaume St. Hilaire, *Traité des Arbres Forestiers*, t. 53. — Loudon, *Arb. Brit.* iii. 1670, f. 1533, t. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 32 (*Revisio Populorum*); *Hist. Vég.* x. 391. — Seringe, *Fl. des Jard.* ii. 64. — Chapman, *Fl.* 431. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 72. — Gray, *Man.* ed. 5, 467. — Wesmael, *Bull. Féd. Soc. Hort. Belg.* 1861, 328, f. 7 (*Monogr. Pop.*). — *De Candolle Prodr.* xvi. pt. ii. 328; *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 240, t. 20 (*Monogr. Pop.*). — K. Koch, *Dendr.* ii. pt. i. 494. — Porter & Coulter, *Fl. Colorado*; *Hayden's Surv. Misc. Pub.* No. 4, 129. — Lauche, *Deutsche Dendr.* ed. 2, 317. — Coulter, *Man. Rocky Mt. Bot.* 339. — Dippel, *Handb. Laubholzk.* ii. 201. — Koehne, *Deutsche Dendr.* 82.

Populus monilifera, Aiton, *Hort. Kew.* iii. 406 (1789). — Abbott & Smith, *Insects of Georgia*, ii. 141, t. 71. — Willdenow, *Berl. Baumz.* 231; *Spec.* iv. pt. ii. 805; *Enum.* 1017. — *Nouveau Duhamel*, ii. 186. — Persoon, *Syn.* ii. 623. — Desfontaines, *Hist. Arb.* ii. 465. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 400. — Michaux f. *Hist. Arb. Am.* iii. 295, t. 10, f. 2. — Pursh, *Fl. Am. Sept.* ii. 618. — Nuttall, *Gen.* ii. 239. — Hayne, *Dendr. Fl.* 202. — Sprengel, *Syst.* ii. 244. — Watson, *Dendr. Brit.* ii. 102, t. 102. — Loudon, *Arb. Brit.* iii. 1657, f. 1517, t. — Spach, *Ann. Sci. Nat.* sér. 2, xv. 32 (*Revisio Populorum*); *Hist. Vég.* x. 389. — Torrey, *Fl. N. Y.* ii. 215. — Emerson, *Trees Mass.* 249; ed. 2, i. 287. — Waga, *Fl. Pol.* ii. 669. — Seringe, *Fl. des Jard.* ii. 63. — Watson, *Am. Jour. Sci.* ser. 3, xv. 136. — Ward, *Bull. U. S. Nat. Mus.* No. 22, 116 (*Fl. Washington*). — Chapman, *Fl.* ed. 2, Suppl. 649. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 174. — Trautvetter, *Act. Hort. Petrop.* ix. 191 (*Incrementæ Fl. Ross.*). — Watson & Coulter, *Gray's Man.* ed. 6, 487. — Koehne, *Deutsche Dendr.* 82. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 420 (*Man. Pl. W. Texas*).

Populus nigra, β **Virginiana**, Castiglioni, *Viag. negli Stati Uniti*, ii. 334 (1790).

Populus latifolia, Moench, *Meth.* 338 (1794).

Populus glandulosa, Moench, *Meth.* 339 (1794).

Populus dilatata, β **Caroliniensis**, Willdenow, *Berl. Baumz.* 230 (1796).

Populus angulosa, Michaux, *Fl. Bor.-Am.* ii. 243 (1803).

Populus nigra, B **Helvetica**, Poiret, *Lam. Dict.* v. 234 (1804).

Populus Marilandica, Poiret, *Lam. Dict.* Suppl. iv. 378 (1816). — Sprengel, *Syst.* ii. 244.

Populus serotina, Hartig, *Forstculturpfl. Deutschl.* 437 (1851).

Populus angulata tortuosa, Carrière, *Rev. Hort.* 1867, 360. — Wesmael, *De Candolle Prodr.* xvi. pt. ii. 328; *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 241 (*Monogr. Pop.*).

Populus Canadensis, β **discolor**, Wesmael, *De Candolle Prodr.* xvi. pt. ii. 329 (1868); *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 243 (*Monogr. Pop.*).

Populus angulata, a **serotina**, Dippel, *Handb. Laubholzk.* ii. 202 (1892).

A tree, sometimes a hundred feet in height, with a trunk occasionally seven or eight feet in diameter, divided often twenty or thirty feet above the ground into several massive limbs which spread gradually and, becoming pendulous toward their extremities, form a graceful rather open head frequently a hundred feet across, or on young trees are nearly erect above and, spreading below almost at right angles with the stem, form a symmetrical pyramidal head. The bark on the trunk is from an inch and a half to two inches in thickness, ashy gray, and deeply divided into broad rounded ridges broken into closely appressed scales which cover the light yellow inner bark; on young stems and branches it is thin, smooth, and light yellow tinged with green. The branchlets are stout and marked with long pale lenticels, and are terete or, especially on vigorous young trees, become angled usually in their second year, with thin pale more or less prominent wings extending downward from the two sides and the bases of the large three-lobed leaf-scars which are truncate or slightly emarginate above. The buds are resinous, ovate, acute, the lateral much flattened by pressure against the branch, half an inch long, and covered by six or seven light chestnut-brown lustrous scales slightly puberulous toward the base of the bud. The leaves are deltoid or broadly ovate, usually abruptly or gradually acuminate with long slender entire points or rarely rounded at the apex, truncate, slightly cordate or occasionally abruptly wedge-shaped at the base, which is generally entire, and coarsely crenately serrate with incurved glandular teeth; when they unfold they are gummy, fragrant with a balsamic odor, covered more thickly below than above with soft white caducous hairs, and furnished on the margin with a short dense fringe of white deciduous tomentum; and at maturity they are thick and firm in texture, light bright green and lustrous, paler on the lower than on the upper surface, and from three to five inches in length and breadth, with stout yellow midribs often tinged with red toward the base and raised and rounded on the upper side, from five to seven pairs of conspicuous primary veins which spread nearly at right angles with a slight upward curve and are forked at some distance from the margins, slender connecting cross-veins, and rather obscure reticulate veinlets; they are borne on slender petioles pilose at first but soon glabrous, compressed laterally, yellow more or less tinged with red, and from two and a half to three and a half inches in length, and flutter with the lightest breeze; in the autumn they turn clear bright yellow before falling. The stipules of the first leaves are strap-shaped, acute, slightly concave, yellow-green, an inch long, about an eighth of an inch wide, and caducous; those higher on the branch are linear-lanceolate, white and scarious, and often less than half an inch in length. The flower-buds are broadly ovate, obtuse, nearly half an inch long, and covered by about five scales which disappear before the flowers expand. The aments hang on short peduncles and develop before the appearance of the leaves; those of the staminate tree are densely flowered, from three to four inches in length and half an inch in thickness, with stout glabrous stems, and those of the pistillate tree are sparsely flowered and thin-stemmed, and often become a foot long before the ripening of the capsules, which are raised on slender stems from one third to one half of an inch in length; the scales are scarious, light brown and glabrous, dilated and irregularly divided at the apex into filiform lobes, and caducous. The stamens are composed of short filaments and large dark red anthers, and are inserted to the number of sixty or more on a broad oblique disk with slightly thickened revolute margins. The ovary is subglobose, crowned by three or four nearly sessile dilated or laciniately lobed stigmas, and surrounded at the base by a broad cup-shaped membranaceous disk persistent under the fruit. The capsule is oblong-ovate, rather abruptly contracted and acute at the apex, slightly pitted, thin-walled, from one quarter to one half of an inch long, dark green, and three or four-valved. The seed is oblong-obovate, rounded at the apex, light brown, about a twelfth of an inch in length, and surrounded by a tuft of long white or slightly rusty colored hairs which inclose the mature ament in the mass of soft delicate cotton that has given to this tree its common name.

Populus deltoidea inhabits the banks of streams, where it often forms extensive open groves, and is distributed from the valley of the lower Maurice River in the province of Quebec[1] and the shores of

[1] Provancher, *Flore Canadienne*, ii. 533. — Brunet, *Cat. Vég. Lig. Can.* 55. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 56°. — Macoun, *Cat. Can. Pl.* 457.

Lake Champlain in Vermont, through western New England and New York, Pennsylvania west of the Alleghany Mountains, and the Atlantic states south of the Potomac River to western Florida, and westward to the base of the Rocky Mountains from southern Alberta to northern New Mexico. Comparatively rare and of smaller size in the east and in the coast region of the south Atlantic and east Gulf states, the Cottonwood is the largest and one of the most abundant trees along all the streams between the Appalachian and the Rocky Mountains, marking their course over the mid-continental plateau to the extreme limit of tree growth, and growing to its largest size nearly to the one hundredth meridian.

The wood of *Populus deltoidea* is light, soft, and not strong, although close-grained; it is dark brown, with thick nearly white sapwood, and contains numerous obscure medullary rays and minute scattered open ducts. The specific gravity of the absolutely dry wood is 0.3889, a cubic foot weighing 24.24 pounds. Warping badly in drying and extremely difficult to season, it is now used only in the manufacture of paper-pulp, for cheap packing-cases, and for fuel.

The Cottonwood, however, played an important part in the settlement of the prairie states west of the Missouri River before railroads joined the forests of the east with the western plains, furnishing the material for their first buildings from the rough stockade, raised to protect the struggling settler against the Indian, to the hotel and schoolhouse of the infant town.[1]

Populus deltoidea was probably introduced into Europe in the eighteenth century, and the first description of it was published in 1755 by Duhamel, who extolled its value for the decoration of parks.[2] It is still frequently planted in Europe, and no North American tree is more often seen there, the form with bright yellow leaves[3] especially. In the United States no other tree has been so generally planted on the plains and prairies east of the Rocky Mountains. Along the banks of streams in moist soil Cottonwoods have grown with remarkable rapidity and attained a large size, but in dry soil they soon begin to fall, and gradually disappear at the end of a few years, and without irrigation in regions of light and irregular rain-fall they have not proved successful.[4]

With its massive pale stem, its great spreading limbs, and broad head of pendulous branches covered with fluttering leaves of the most brilliant green, *Populus deltoidea*[5] is one of the stateliest and most beautiful inhabitants of the forests of eastern America.

[1] Mason, *Garden and Forest*, iv. 182, f. 34.

[2] *Populus magna Virginiana, foliis amplissimis, ramis nervosis, quasi quadrangulis, Traité des Arbres*, ii. 178 (excl. syn. Clayton).

[3] *Populus Canadensis*, d *aurea*, Dippel, *Handb. Laubholzk.* ii. 200.

[4] Corbett, *Garden and Forest*, viii. 173. — Waugh, *Garden and Forest*, viii. 502.

[5] *Populus deltoidea* is sometimes called the Carolina Poplar in European gardens, where it is also known as the Necklace Poplar on account of the supposed resemblance of the elongated fruiting aments and their long-stemmed capsules to strings of beads. (See Loudon, *Arb. Brit.* iv. 1657.) In France it has long been known as le Peuplier suisse (Mathieu, *Flore Forestière*, ed. 3, 439).

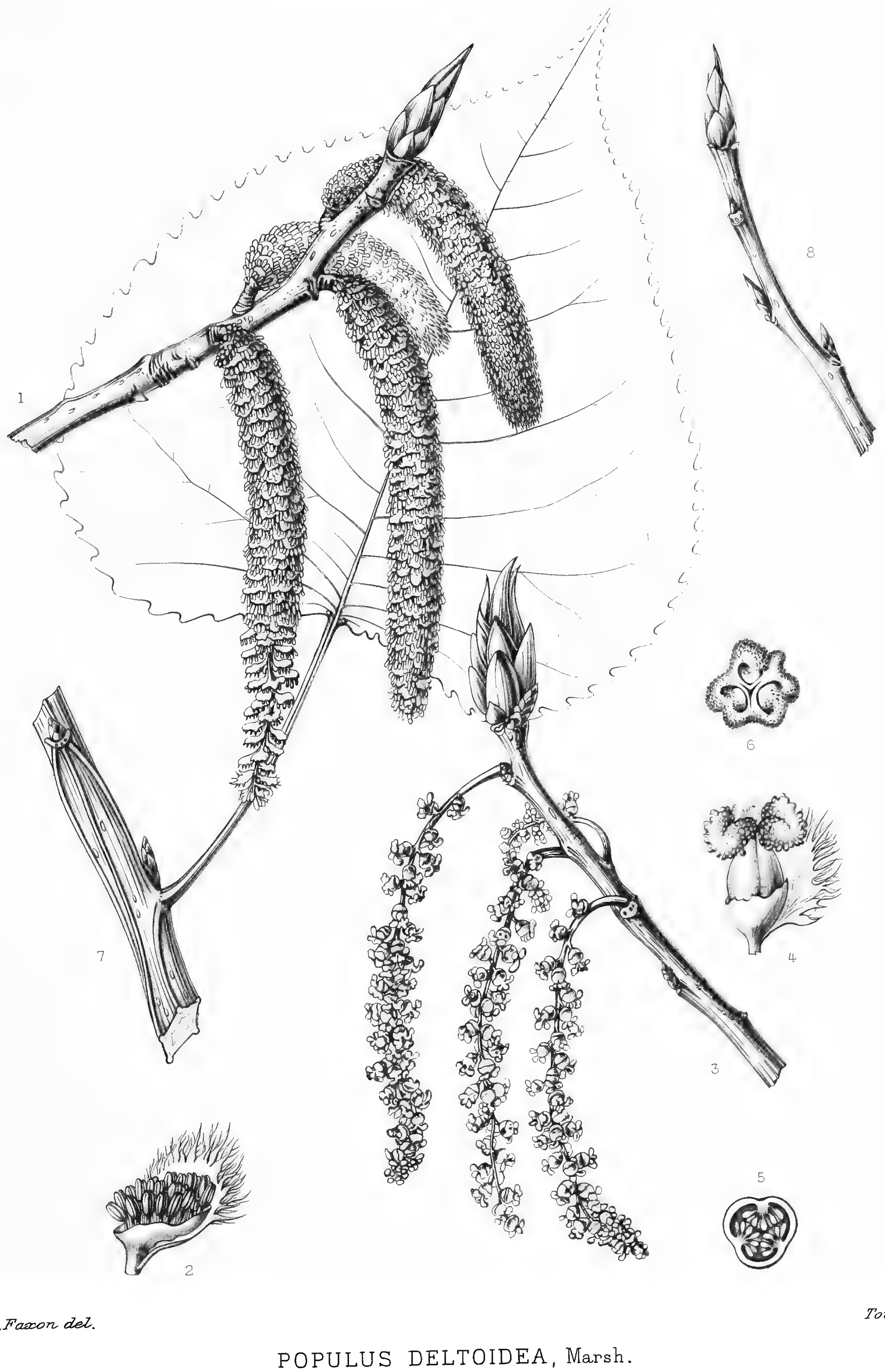
EXPLANATION OF THE PLATES.

Plate CCCCXCIV. Populus deltoidea.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower with its scale, enlarged.
5. Cross section of an ovary, enlarged.
6. A stigma seen from above, enlarged.
7. Portion of a branch with a leaf, natural size.
8. A winter branch, natural size.

Plate CCCCXCV. Populus deltoidea.

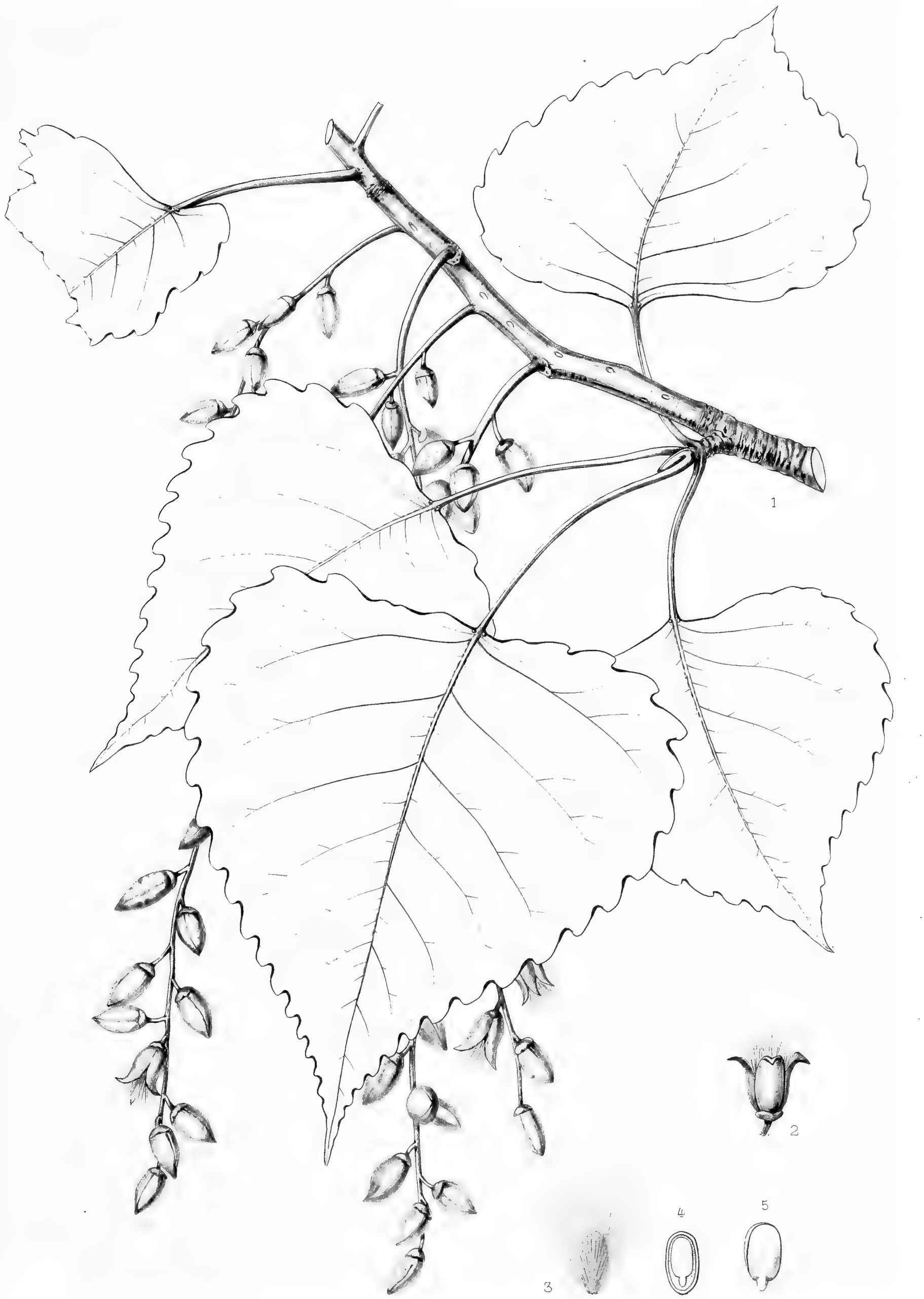
1. A fruiting branch, natural size.
2. A fruit with open valves, enlarged.
3. A seed, magnified.
4. Vertical section of a seed, magnified.
5. An embryo, magnified.



C.E.Faxon del. Toulet sc.

POPULUS DELTOIDEA, Marsh.

A. Riocreux direx.t Imp. J. Taneur, Paris.



C.E.Faxon del.

Himely sc.

POPULUS DELTOIDEA, Marsh.

A.Riocreux direx.t

Imp. J.Taneur, Paris.

POPULUS FREMONTII.

Cottonwood.

LEAVES deltoid or reniform, usually short-pointed at the apex, coarsely and irregularly crenately serrate, their petioles laterally compressed.

Populus Fremontii, Watson, *Proc. Am. Acad.* x. 350 (1875); *Am. Jour. Sci.* ser. 3, xv. 136. — Brewer & Watson, *Bot. Cal.* ii. 92. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 175. — Dippel, *Handb. Laubholzk.* ii. 201, f. 96. — Koehne, *Deutsche Dendr.* 82. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 420 (*Man. Pl. W. Texas*). — Coville, *Contrib. U. S. Nat. Herb.* iv. 200 (*Bot. Death Valley Exped.*). — Greene, *Man. Bot. Bay Region*, 301.

Populus monilifera, Torrey, *Sitgreaves' Rep.* 172 (not Aiton) (1853); *Bot. Mex. Bound. Surv.* 204; *Ives' Rep.* 27; *Bot. Wilkes Explor. Exped.* 468. — Bigelow, *Pacific R. R. Rep.* iv. 21. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 89. — Watson, *King's Rep.* v. 327; *Pl. Wheeler*, 17. — Coville, *Contrib. U. S. Nat. Herb.* iv. 200 (*Bot. Death Valley Exped.*).

Populus Canadensis, Wesmael, *De Candolle Prodr.* xvi. pt. ii. 329 (in part) (not Moench) (1868); *Mém. Soc. Sci. Hainaut*, sér. 3, iii. 242 (*Monogr. Pop.*) (in part).

Populus Fremontii, var. (?) **Wislizeni**, Watson, *Am. Jour. Sci.* ser. 3, xv. 136 (1878); *Proc. Am. Acad.* xviii. 157. — Brewer & Watson, *Bot. Cal.* ii. 92. — Rusby, *Bull. Torrey Bot. Club*, ix. 79. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 420 (*Man. Pl. W. Texas*). — S. B. Parish, *Zoë*, iv. 348.

A tree, occasionally a hundred feet in height, with a short trunk five or six feet in diameter, and stout spreading branches pendulous at the extremities and forming a broad rather open graceful head. The bark on the trunks of old trees is from an inch and a half to two inches in thickness, dark brown slightly tinged with red, and deeply and irregularly divided into broad connected rounded ridges covered with small closely appressed scales which in falling display the bright red inner bark; on young stems it is light gray-brown, much thinner, and smooth or only slightly fissured. The branchlets are terete and slender, and when they first appear are light green and covered with short pale caducous pubescence; they become light yellow before winter, and in their second year are dark or light gray more or less tinged with yellow, and but slightly roughened by the small three-lobed leaf-scars. The buds are ovate, acute, and covered with light green lustrous scales, the terminal bud being about a third of an inch in length and usually two or three times as large as the lateral buds, which are much flattened by pressure against the stem. The leaves are deltoid or reniform, generally contracted into broad short entire points or rarely rounded or emarginate at the apex, truncate, slightly cordate or abruptly wedge-shaped at the wide entire base, and coarsely and irregularly crenately serrate with few or many incurved gland-tipped teeth; when they unfold they are coated, like the petioles, with short spreading pale caducous pubescence, and at maturity are thick and firm in texture, bright green and lustrous, from two to two and a half inches long and from two and a half to three inches wide, with thin yellow midribs raised and rounded on the upper side and four or five pairs of slender veins spreading at slightly oblique angles, forked at some distance from the rather thickened and revolute margins, and connected by obscure reticulate veinlets; they are borne on flattened yellow petioles from an inch and a half to three inches in length, and turn a clear or dull yellow in the autumn before falling. The flower aments appear in February or March; on the staminate tree they are densely flowered, from one and a half to two inches long and nearly half an inch broad, with slender glabrous stems, and on the pistillate tree they are sparsely flowered, and about two inches in length when the flowers open, with stouter glabrous or puberulous stems, the staminate and pistillate aments occasionally appearing together on the same branch; their scales are light brown, thin and scarious, dilated, and irregularly cut into filiform lobes at the apex, and caducous. The stamens, with large dark

red anthers, to the number of sixty or more, are inserted on a broad oblique disk with slightly thickened and entire margins. The ovary is ovate or ovate-oblong, glabrous, surmounted by three broad irregularly crenately lobed stigmas, and inclosed at the base in a broad cup-shaped membranaceous disk which is persistent under the fruit. The capsules are ovate, acute or obtuse, slightly pitted, thick-walled, three or rarely four-valved, from one third to nearly one half of an inch long, raised on stout stems from one twelfth to one sixth of an inch in length, and borne in slender drooping racemes four or five inches long. The seeds are nearly an eighth of an inch in length, ovate, acute, light brown, and surrounded by a thick tuft of long soft white hairs which entirely cover the mature ament with masses of white cotton.[1]

Populus Fremontii, which was long confounded with *Populus deltoidea* of the eastern states, is distributed from the valley of the upper Sacramento River southward through western California to Lower California,[2] and eastward to central Nevada, southern Utah, southern Colorado, western Texas, and northern Mexico. The Cottonwood lines the banks of streams in all this great territory, and is exceedingly abundant in the valleys of central California, where it grows to its largest size, and in all the region adjacent to the boundary between the United States and Mexico.

The wood of *Populus Fremontii* is light, soft, close-grained but not strong, liable to warp badly in drying, and difficult to season; it is light brown, with thin nearly white sapwood, and contains very obscure medullary rays and minute scattered open ducts. The specific gravity of the absolutely dry wood is 0.4767, a cubic foot weighing 29.71 pounds.

The inner bark was made into petticoats by the Indians of some of the tribes of the southwest.[3]

Splendid avenues of *Populus Fremontii* adorn the streets and squares of the cities of northern Mexico, where it has long been planted as a shade-tree.[4] In the southwestern United States it is now cultivated for the same purpose, and for the fuel which pollarded trees produce quickly and abundantly.

The presence of the Cottonwood indicates the existence of water to the traveler on the arid deserts of the Mexican plateau, cheering him with the hope of repose and grateful shade, and enlivening the sunburnt plains with a freshness and beauty which are unequaled in early spring before drought has parched its leaves or the larvæ of the Tussock Moth have stripped them from its branches.[5]

[1] Sereno Watson distinguished the tree of the territory adjacent to the boundary between the United States and Mexico as his variety *Wislizeni* by its sharply acuminate leaves cuneate or slightly truncate at the base, less dilated staminate disk, shorter pedicels, slender pistillate ament, and angled three or four-valved capsules, but these characters are by no means constant or reliable, and I cannot separate the Cottonwood of the Mexican plateau and southern California from the inhabitant of the valleys of the central part of that state.

[2] Brandegee, *Proc. Cal. Acad.* ser. 2, ii. 205 (*Pl. Baja Cal.*).

[3] Havard, *Garden and Forest*, iii. 620.

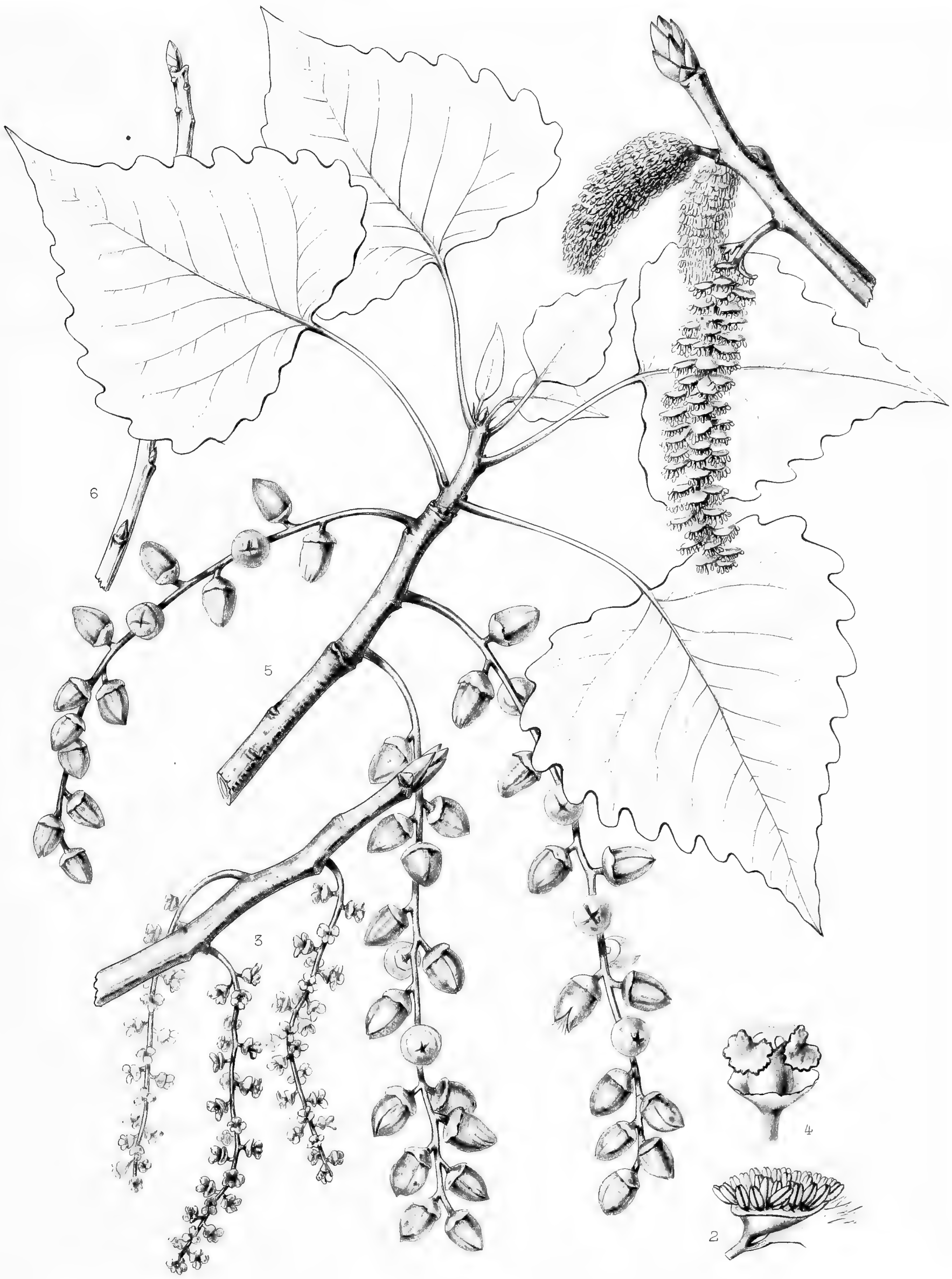
[4] C. G. Pringle, *Garden and Forest*, i. 105, f.

[5] In southern New Mexico and Arizona and in northern Sonora the leaves are usually entirely devoured by the larvæ of *Hyphantria cunea*, Hübner. The eggs of this moth are deposited on the branches and the larvæ are hatched as the leaves are unfolding. During May their webs are fully developed and the trees defoliated. After the rains of July and August a second crop of leaves is produced, which fall late in the autumn.

EXPLANATION OF THE PLATE.

PLATE CCCCXCVI. POPULUS FREMONTII.

1. A flowering branch of the staminate tree, natural size.
2. A staminate flower with its scale, enlarged.
3. A flowering branch of the pistillate tree, natural size.
4. A pistillate flower, enlarged.
5. A fruiting branch, natural size.
6. A winter branch, natural size.



C.E. Faxon del.

Himely sc.

POPULUS FREMONTII. Wats.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

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